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CRD Directs 20-Year Technical Forecasts

Theme of the Month

By Lieutenant General E. C. Itschner
Chief of Engineers, U.S. Army

The Engineer's lot in warfare is wrapped up in terrain. He must classify, map, bridge, modify, and build on and of it to fit the demands of battle. Like other combat arms, he must fight on it. Engineering-wise, he must run the alphabetical gamut from airfields to water supply; scientifically, he must explore the range from astronomy to wave mechanics. Our activities embrace the world from pole to pole; from the tight road nets of Europe to the densely vegetated, largely impenetrable hills of Southeast Asia. The Engineer's lot is unique in that he is called upon to modify his element in the face of batte.

Of necessity there are many theories about future warfare woven from such fabrics as nuclear or non-nuclear weapons, the communication nets of Europe and the jungles of Laos. From these emerge limits which on one hand would involve unbridled use of nuclear

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Foresight for the timely development of the weapons systems and other military equipment of the future—a visionary, vital approach to the U. S. Army's constant objective of remaining superior to the potential enemy in all respects—is strongly reemphasized in a newly initiated program of technological forecasting.

Scheduled for submission this month to the Chief of Research and Development are summary technological forecasts prepared by each of the Technical Services. Following Lt Gen Arthur G. Trudeau's review, in line with the greatly expanded powers assigned to him in August 1960, the reports will be published and distributed Army-wide, about June 1.

Purpose of the forecasts is to aid the long-range Army planners in formulating new concepts and requirements, within as realistic a time structure as is foreseeable. Forecasting for the R&D program is to be on a sound basis of completely integrated information regarding the state-of-the-art and the overall capabilities of the Army research and development in-house, contractual and grants activities.

The concept of technological forecasting is not new, per se. Forecasts have been included in normal planning of the various Technical Services and for several years in the LORD (Long-Range Research and Development) publications distributed, beginning in 1957, by OCRD. Last year forecasts were contained in special

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Siu Honored Among 10 Careerists

Dr. Robert G. H. Siu, long recognized as one of the Army's most distinguished scientists, was honored at a dinner Mar. 20 in the Sheraton-Park Hotel, Washington, D.C., as one of the Nation's 10 outstanding Federal Government career employees for 1961.

Dr. Ralph G. H. Siu

Selections are made each year by the National Civil Service League. In 1959 Dr. Richard A. Weiss, Deputy and Scientific Director, Army Research Office, Office of the Chief of Research and Development, won the same honor.

Dr. Siu is Technical Director of Research and Development, Research and Engineering Division, Office of the Quartermaster General. He was cited as a "recognized international scientist and a forceful leader among men who strive to focus scientific thought and development upon new horizons."

The citation noted that Dr. Siu is the "key scientist in the radiation-preservation-of-foods field" and has been the "dynamic impetus behind a

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CONARC Planning 9 Man - Machine Seminars

In the interest of advancing design and development of equipment embodying the results of thoughtful consideration of the growing problem of man-machine compatability, the U.S. Army Continental Army Command is proposing a series of nine engineer seminars this spring.

Intended to familiarize supervisory, liaison and technical personnel and design engineers with current problems posed by the increasing complexity of military equipment, the seminars are expected to be attended by more than 600 participants.

Arrangements are being made by the Material Developments Sec-

(*Continued on page 2*)

Army R&D Newsmagazine

Vol. 2, No. 4 APRIL 1961

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Objectives of this publication are: To improve informal communication among all segments of the Army scientific coummunity and other Government R&D agencies; to further understanding of Army R&D progress, problem areas and program planning; to stimulate more closely integrated and coordinated effort among the widely dispersed and diffused Army R&D activities; to maintain a closer link from top management through all levels to scientists, engineers and technicians at the bench level; to express views of leaders, as pertinent to their responsibilities, and to keep personnel informed on matters germane to their welfare and pride of service.

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Theme of the Month

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weapons on an atomic battlefield and on the other a choice by an enemy of that battlefield of least advantage to our mechanized Army.

Rejecting mass genocide as a thesis, it becomes most likely that the Engineer will be called upon to do prodigious tasks to support battle in the undeveloped portions of the world where, by our national tradition, we may allow an enemy to pick his battlefield. At the same time, we must not neglect the requirements for mobility and survival on an atomic battlefield.

To do this job, we are busily engaged in improving our means of providing Engineer support. Illustrative of this effort is the development of an all-purpose ballastable tractor, a mobile assault bridge-ferry, new geodetic and mapping systems, portable nuclear power reactors, and a host of equipment.

This may not be enough, however, particularly if we deal with an enemy willing to contaminate the world. Under these circumstances, firepower would far exceed construction power so that our ability to survive would be measured by our ability to recover in a timely manner. The task may well exceed by many fold the present capacity of the combined construction forces on earth. To face this problem we need new concepts, and this means research. Our future demands that we acquire new knowledge of how to do our job better and ever more quickly.

In actuality this is difficult because our basic raw material, terrain, is made up of many complicated and variable elements. Yet in a broad sense this makes the effort that much more challenging, and the result potentially that much more profitable. We dare hope that in our search for this new knowledge there may be found new concepts in the conduct of land warfare.

CONARC Plans 9 Man-Machine Seminars in April, May

(*Continued from page 1*)

tion of USCONARC in conjunction with the Human Factors Research Division, Army Research Office, Office, Chief of Research and Development.

As stated by one of the project officers in outlining tentative plans:

"For some time the Department of Defense has been concerned over the ever increasing complexity of military equipment. This trend not only makes the equipment difficult to operate and maintain, but tends to increase its weight and cost.

"Any equipment which is to be used by man should be designed to suit his body measurements and mental ability. Too often equipment has been built to meet the technical requirements of the designers, rather than the needs of the potential user.

"In most instances, timely human factors engineering considerations would have precluded such development. Human engineering places major emphasis upon *speed, accuracy, compatibility,* and *safety* of human performance in the use and operation of equipment under diverse conditions.

"The successful design of equipment for military use requires consideration of the following basic human characteristics: sensory capabilities, mobility and muscle strength, intellectual abilities, common skills and capacity for learning new skills, capacity for team or group effort, body dimensions, and effects of working environment upon human performance. . . ."

The stated requirement of the seminars is to stimulate Material Developments personnel "to continuously analyze and determine the appropriate application of basic scientific principles concerning human physical characteristics to the design and development of hardware and equipment, so as to increase speed and precision of operations, provide maximum maintenance efficiency, reduce fatigue, simplify operational requirements, and reduce cost."

The seminars are planned for all officers, appropriate civilians and senior noncommissioned officers at each USCONARC (CONUS) Board. Tentatively, each will consist of 16 hours of presentations and discussions, broken down into four sessions. Information gained from many Department of Defense agencies, industries and institutions will be presented.

As proposed, the schedule of seminars is: Armor Board, Fort Knox, Ky., Apr 17; Airborne and Electronics Board, Fort Bragg, Ky., Apr 24; Infantry Board, Fort Benning, Ga., May 1; Aviation Board, Fort Rucker, Ala., May 8; Artillery Board, Fort Sill, Okla., May 15; Air Defense Board, Fort Bliss, Tex., May 22.

Contemplated but still unscheduled are seminars of the Human Engineering Laboratories at the Ordnance Corps Aberdeen Proving Grounds, Md., Headquarters U.S. Army Transportation Research Command at Fort Eustis, Va., and the Corps of Engineers Engineering Research and Development Laboratories, Fort Belvoir.

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CRD Directs 20-Year Technological Forecasts

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reports prepared by the Technical Services at the request of Headquarters, U.S. Army Continental Army Command (CONARC).

What is new under the current OCRD program is the placing of primary attention on technological forecasting as a separate but integrated function of programing, for the optimum benefit of all types of Army planners. Toward this end, the program calls for annual scientifically oriented forecasts, each covering a period of at least 20 years. Input of information and ideas come from and are to be disseminated to all levels among planners, technicians, scientists and management personnel.

Initiation of OCRD's program to improve the Army's capabilities in Technological Forecasting and the Long-Range Planning of Research and Development resulted from recent studies, including the Roderick Board Report, and discussions at a conference held last September at the Diamond Ordnance Fuze Laboratories.

Speakers at the conference represented the Army General Staff, CONARC, the Army Technical Services, the Joint Chiefs of Staff, Navy and Air Force, and the Army-supported Operations Research Office, Johns Hopkins University. Presentations were designed to highlight existing organization and procedures for long-range planning and forecasting, in order to stimulate panel discussions which followed the addresses.

The various panels made an effort to answer a set of questions concerning possible modification of the Army's technological forecasting program and procedures, submitted by Maj Gen William J. Ely, Director of Army Research.

Shortly after the conference, an OCRD request instructed each of the Technical Services how to "prepare a Technological Forecast, extending at least 20 years in the future and including all subject matter areas appropriate to the Technical Service mission."

"Technological Forecasts should include," it was stated, "discussion of new scientific and technological capabilities arising from advances in basic and applied research and of their possible significance to the Army.

"Wherever practicable, these discussions should be related to possibilities for new end items or systems and for progress toward attainment of the Qualitative Materiel Development Objectives included in the Combat Development Objectives Guide and of the Long Range R&D Materiel objectives established in this office.

"Estimates should be made as to when important new technical advances may be expected, and when new or improved materiel could be made available. Items already in the development or testing phase should not be included in the Forecast.

"Forecasts must be timely, readable, and interesting. They should be written in language understandable by readers having only modest technical knowledge, should be well edited and indexed, and should utilize modern methods of graphical representation wherever practicable. . . . Discussion should cover the basis for prediction and give an indication of the level of confidence which the forecasting agency has in its predictions."

Publication of the forecasts will be on a yearly basis, with distribution on or about June 1 of each year. Forecasts are to be revised, either in whole or in part, whenever it is considered necessary or desirable.

Technological forecasting in broader areas of Army-wide interest, not considered to be within the mission of the Technical Service originating a forecast, must be forwarded to the OCRD by Apr. 1 of each year "for inclusion in an overall Army Technological Forecast which may also include Army-wide discussion of topics of universal interest such as Human Factors, Materials and Operations Research."

OCRD has directed that each Technical Service shall designate an individual or group in the Washington area to be responsible for preparation of the Service's Technological Forecasts. These individuals or groups will consult with OCRD during development of the Army-wide Technological Forecast. Each of the Technological Forecasts compiled by the Technical Services will include an index of contents. OCRD plans to provide a general index covering all the forecasts.

Maj Gen Beach Assigned to OCRD Effective in May

Secretary of the Army Elvis J. Stahr, jr., has announced the assignment of Maj Gen Dwight E. Beach to the Office, Chief of Army Research and Development, Washington, D.C., effective in May. General Beach is presently Commanding General, 82nd Airborne Division, Fort Bragg, N.C.

Brig Gen Theodore J. Conway, now Assistant Division Commander of the 82nd Airborne Division, will assume command of the division upon the departure of General Beach. General Conway was the first Director of Army Research, and has been nominated and confirmed by the Senate for promotion to major general.

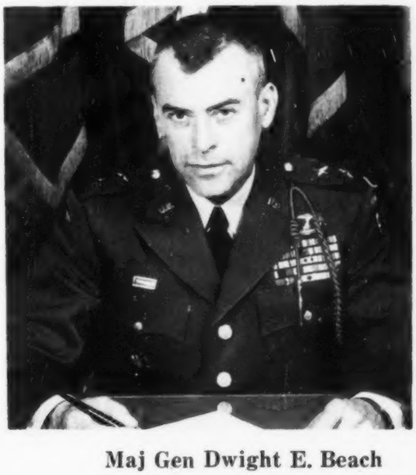
Graduated from the United States Military Academy in 1932, General Beach attended the University of Michigan for two years before enrolling at the Academy. He was born in Chelsea, Mich., July 20, 1908. Prior to World War II he served with various field artillery units.

Assigned to the Southwest Pacific shortly after Pearl Harbor touched off the war with Japan, he organized and commanded the 167th Field Artillery Battalion. With the 21st Infantry Division he engaged in campaigns through New Guinea to the Philippines and Japan. He participated in amphibious assaults at Aitape, Maffin Bay, Wakde and Palawan and in follow-up operations in Biak and Zamboango.

Since World War II he has commanded the artillery of the 11th Airborne Division, the Artillery of the 45th Infantry Division in Korea, and served as Artillery Officer and Deputy Chief of Staff for Plans and Combat Operations, Eighth United States Army in Korea. In November 1954, he was appointed Chief of Staff, Eighth U.S. Army.

General Beach then was assigned to Fort Bliss, Tex., as Director of the Office, Special Weapons Development, U.S. Continental Army Command for two years, following which he served more than three years as Director of Guided Missiles, Office of the Deputy Chief of Staff for Military Operations, Washington, D.C.

During his service, General Beach has been an instructor at the United States Military Academy, the Field Artillery School, the Command and General Staff College, and the Army War College.



Maj Gen Dwight E. Beach

Project Vector Exploits R&D Value of Time

By Eldon S. Sweezy, Special Assistant
To Chief, R&D Division, Ordnance Corps

Technical forecasting in a military research and development setting has the objective of increasing our ability to obtain the maximum advantage from the fact that any potential enemy has no more time than we do. From this indisputable equality, we can maintain a position of military superiority or parity *if we use time with greater economy than he does.* The lead times required in the translation of basic knowledge into fighting capability force us to act today to achieve economy of time in distant time frames.

The Ordnance Corps is attempting to achieve this purpose through Project Vector—a long-range forecasting and planning concept. Three objectives are to be met by the results of Project Vector:

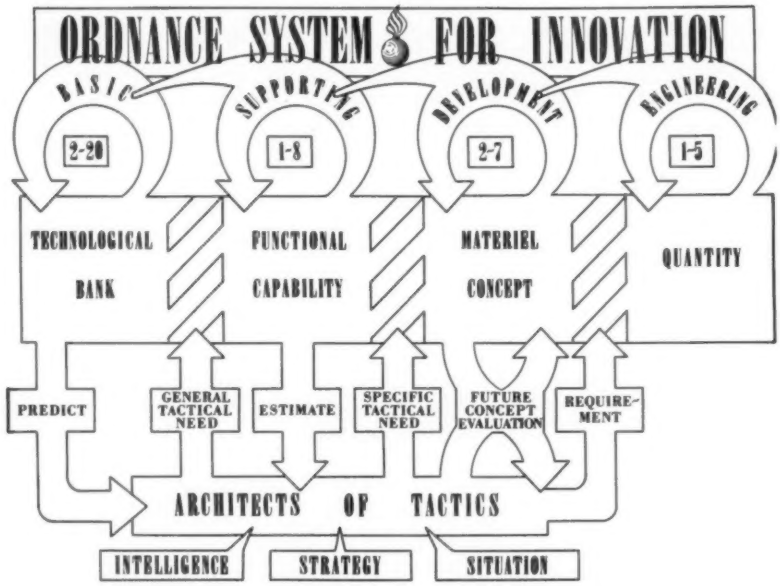
1. We will be able to respond more quickly with appropriate technology to meet future tactical problems as they are recognized.

2. We can focus resources on barrier problems long before they can block specific weapon development.

3. We can aid the tactician in exploiting growing technological capabilities to the maximum.

Before we can talk meaningfully about technical forecasting, we must distinguish between a forecast, an objective, a plan and schedule, and a report. There has been apparent a great deal of confusion about these quite different things. A forecast is obviously a prediction of things to come, and the probable consequences of those events. This prediction may have an impact upon objectives, but it does not amount to the same thing. An objective is the purpose or final result we wish to achieve. A plan is the sequence of actions required to achieve that objective. While a schedule can be either the timetable or resource-timetable for the sequence of actions required by the plan, a report is, on the other hand, a statement of what is or was. It may or may not include a forecast. It may or may not describe the significance of the events reported.

To be usable, a technical forecast must meet some operational and technical criteria. Failure of the forecast to meet these criteria will cause waste of time, resources and, more significantly, a loss of fighting capability. The technical adequacy of the forecast depends upon the ability of the scientific personnel of the organization to keep in touch with world science, and to interpret their knowledge of the accomplishments, interests, methods, and vigor of art groups into estimates of the rate and direction in which technology is moving. Information about what is taking place, and where, must be collected widely and accurately.



Despite the present lack of precision with which forecasts can be made, it is possible to achieve three features:

1. Accuracy can be stated in most instances within definable probabilities and confidence levels.

2. Accuracy can be improved by recognition of three types of error-occurrence, magnitude and time.

3. Accuracy of forecasting is easier to achieve as we move toward production.

The forecast must be made in terms of recognizable, meaningful factors that are understandable in related fields as well as by the specialist directly involved. The maximum value of the technical forecast arises from the integration of related fields in future time frames. Progress in any of the multitude of art fields from which information is derived by scientific method is directly affected by output from other fields. The forecast must, therefore, reflect the effects of improved tools for research as well as direct contributions of knowledge. These improved tools may come from seemingly remote fields.

Forecasts may be fun when done out of curiosity, but Project Vector has a definite operational purpose. It is directed to a specifiable audience. The forecast needs to speak directly to that audience in *its* operating language. Since the nonspecialist as well as the specialist must be able to use the forecast, it must be current and understandable in terms of current perceptions. Stale forecasts are soon outcasts. It must always be remembered that the operational value to the tactician and the technician is directly influenced by the extent to which he perceives the forecast as applying to current or future problems that he has seen or can quickly recognize.

Production of a technical forecast which meets these technical and operational criteria is an integral part of the responsibilities of the Ordnance System for Innovation—its R&D organization. To understand the relationship of this forecast of the normal functioning of a vigorous R&D organization, it would be well to examine briefly a model of the system.

The Ordnance System for Innovation is responsible for obtaining basic knowledge and converting it ultimately into a design which can be produced. In Fig. 1 this is shown at various stages: the technological bank; conversion into functional capability; translation of these capabilities into materiel concepts which can then be produced in quantity.

Inputs from the architects of tactics (CONARC, the service boards, etc.) are the basis upon which the System for Innovation can convert information. When, for example, a specific tactical need is stated, as in

MOMAR, the functional capabilities are then translated into concepts for specific materiel. If those functional capabilities do not exist at the desired levels, supporting research, requiring one to eight years, will be necessary —if basic knowledge is in the technological bank. If not, the barrier problem will be distilled off and put into the basic research cycle which should, within the period 2 to 20 years, place the basic knowledge in the technological bank.

The role of Project Vector can be seen in the outputs of prediction, estimate, and future concept evaluation. These elements of the forecast will provide the architects of tactics with sound technical knowledge upon which they can proceed with the development of future tactical doctrine and organization that is more reasonably within the reach of future technology.

The generation of the forecast occurs in the actual operating organization which feeds its interpreted information into the elements of the organization structure which correlate and integrate all other technical management information. A small group has been established as a coordinating committee to assist in the final integration of this extensive forecast.

The conversions of information shown in Fig. 1 suggest a logical organization pattern for the information. Basic trends in technology will affect several functional capabilities, which in turn will each affect several types of materiel. Simplicity of presentation, therefore, is achieved best by treating these three stages in sequence. The language required for each stage is different. The approach of the audience to each stage is different.

From the experience gained to date, we know that we must continue to seek better methods for the collection and presentation of our forecasts. Among the techniques now being explored is the identification of subdivisions of knowledge, not necessarily classic discinline and sub-discipline. Several of these lattices have

PROPERTIES OF MATERIALS

I	SOLIDS					FLUIDS	
PROPERTIES	METALS AND ALLOYS	CERAMICS AND GLASS	POLYMERS AND ELASTOMER	SEMI-CONDUCTOR	IONIC CRYSTALS	LIQUIDS	GASES
ELECTRICAL AND MAGNETIC							
THERMAL							
MECHANICAL							
RADIATION							
ATOMIC							
CHEMICAL							

FIGURE 2

ENERGY TRANSFORMATION SYSTEMS

II	OUTPUT ENERGY					
INPUT ENERGY	ELECTRICAL	THERMAL	MECHANICAL	RADIATION	NUCLEAR	CHEMICAL
ELECTRICAL			MOTORS			
THERMAL					FUSION PROCESS	
MECHANICAL						
RADIATION						
NUCLEAR		REACTORS				
CHEMICAL	FUEL CELLS		EXPLOSIVES			

FIGURE 3

been prepared for experimental use. They seem to offer considerable help in the identification of art groups, in the improvement of intergroup communication, and in the discovery of appropriate language for forecasting.

Figures 2 and 3 illustrate this approach. Fig. 2 is a lattice based upon systems for transformation of energy. Other lattices which are being tried out relate energy output systems to the various functional capabilities; functional capabilities to military functions; and military functions to specific types of materiel. It is already apparent that these devices will enable us to identify significant gaps in our coverage of art fields crucial to the successful design of superior weapons as well as to inventory our in-house and contractor capabilities.

In conclusion, long-range technical forecasting appears likely to be most successful when it is treated as a part of the normal operational pattern of a vigorous R&D organization. In this way, it will keep that organization alert to changes in technological capabilities and the implications of these changes for future military problems. The forecast must be accurate, stated in meaningful language, and provide for a linking of related fields. Its operational validity is dependent upon its relationship to current accepted problems, and its understandability to the nonspecialist as well as to the scientific specialist. It must always be remembered that the purpose of technical forecasting in the military setting is the achievement of economy of time in relation to our ability to exploit technological capability to meet real military needs.

Finally, the technical forecaster and his audience must recognize that the forecast is made and published under the pragmatists' oath: "I swear to tell the approximate truth, the tentative truth, the relative truth, so help me future experience."

Titanium Case Hailed As Significant Advance In Missile Technology

Hailed as a "major advance in missile technology" is an improved high energy, solid propellant rocket motor using a lightweight, high-strength motor case made of titanium, which has been successfully static-fired at Redstone Arsenal, Huntsville, Ala.

Maj Gen John A. Barclay, Deputy Chief of the U.S. Army Ordnance Missile Command, said the titanium case, nearly 30 percent lighter than steel cases currently used, made the motor the highest performance, full-size metallic propulsion unit, pound for pound, ever successfully fired in the United States. He said an advanced solid propellant rocket fuel was used in the "completely successful" 40-second test.

While titanium's weight-saving characteristic is important, the outstanding property of the metal is durability. In tests of its resistance to corrosive agents, a sub-scale titanium case was undamaged after 60 days of constant exposure to a saltwater spray. Sub-scale steel casings similarly tested were rendered useless after 7 to 14 days.

General Barclay said the rocket motor test was part of the Army's continuing efforts to produce the most efficient defense weapons possible through extensive research and development programs. He said the application of titanium in meeting future missile requirements is being studied.

TADAS Exercise Shows Teamwork of Services

An example of inter-service cooperation and utilization of equipment was provided during successful demonstrations of the Tactical Air Defense Alerting System (TADAS) at Fort George G. Meade, Md., by the U.S. Army Signal Air Defense Engineering Agency.

Utilizing a helicopter as an elevated platform for detection radar equipment, TADAS gives coverage against low flying aerial targets beyond defiladed areas.

Representatives from the Office of the Chief of Research and Development, Deputy Chief of Staff for Military Operations, U.S. Continental Army Command, U.S. Army Advance Command, Office of the Chief Signal Officer, the Navy and Marine Corps witnessed the demonstrations.

The Navy provided the helicopter; the Marine Corps, ground terminal equipment; the Air Force, generators and ground to air communication equipment; USCONARC, the radar.

ASTIA Facilitates Work of DOD Researchers

Did you know there is a central clearing house able to supply you with any one of 600,000 technical reports to assist you in your research?

Evidence indicates that many eligible to use the Armed Services Technical Information Agency's service do not know about it, and even fewer know how to use the service effectively.

ASTIA has been active since 1951. This year about 3,200 military officers and private industries contracting with the military will ask ASTIA to supply them with almost 700,000 copies of technical reports.

Another 6,000 government and military scientists and engineers will walk into ASTIA regional offices (see box) and ask to see desired technical documents. About 3,000 users will ask ASTIA to prepare a bibliography listing all of the information the Agency has on a particular area of research.

Approximately 150,000 military and industry scientists and engineers will look through ASTIA's Technical Abstract Bulletin, a semimonthly publication, listing the some 25,000 new technical reports ASTIA catalogues each year.

ASTIA has an annual budget of $2,720,000 and a staff of 351 to handle a workload that averages 2,600 requests daily.

Established by a Department of Defense Directive dated May 14, 1951 (since replaced by DOD Directive No. 5160.4 Feb 21, 1955), ASTIA has the mission of providing "a central service within the Department of Defense for the efficient interchange of scientific and technical information. . . ."

Before World War II, professional journals and societies were able to keep scientists abreast of developments in their area because so little of basic or even applied research was classified.

Since World War II intensified research activity in almost every area of possible interest has resulted in an avalanche of technical reports. Because of the volume and because many reports have been classified, scientists often have had more difficulty in obtaining desired information. Lack of communication has contributed to duplication. Unable to determine the most practical starting point for a research or development project, scientists have been hampered in trying to eliminate needless repetition or to avoid gaps in research.

The above files contain a portion of the more than half a million technical reports covering virtually every field of science, collected and catalogued by the Armed Services Technical Information Agency for the benefit of military, government and industry scientists and engineers, stored at Arlington Hall, Va.

The formation of ASTIA for centralized cataloguing and announcement of Defense-generated scientific documents did not completely solve the problem. ASTIA, which was put under the control of the Air Force's Air Research and Development Command for administrative purposes, found it impossible to keep up with the growing demand for service. Also, under the tri-service regulation which governs its operations, ASTIA was not permitted to handle many reports for security and allied reasons.

Consequently, many specialized reference units—close to 100 of them, by recent calculation—have been established within the three services to provide information beyond the limitations of ASTIA's authority or resources. Many of these specialized services duplicate ASTIA's functions in varying degrees.

Early in 1960, after almost two years of preparatory effort, ASTIA installed an electronic data processing system initially designed to virtually double the ASTIA capability. In ASTIA's two major workload areas—document requests and bibliography requests—demands for service are already taxing the doubled capacity, and ASTIA is hard at work figuring out any means of meeting even greater future demands.

ASTIA Services.—ASTIA is a depository of more than 600,000 technical reports covering almost every conceivable scientific subject. About 25,000 reports are added each year. Submitted by military laboratories, universities, contractors, and industrial research laboratories, these reports include all secret, confidential and unclassified scientific material except in certain highly sensitive areas. Not included in the collection are Top Secret, Restricted Data Documents, and information published in books and periodicals.

For easy referral, ASTIA has broken down the body of scientific research into 33 divisions, each of which has many sections. A specific report may pertain to many scientific divisions, and many sections of divisions. An incoming report is given a code indicating which divisions and sections of divisions it pertains to, and an abstract is prepared for easy determination of what the document contains.

The key to the ASTIA storehouse of information is a bibliography, which contains not only general catalogue and index information but abstracts where appropriate. Bibliographies are furnished in the form of catalogue cards except in areas such as Bioastronautics and Rocket Propellants, where demand has been so great that a compilation has been printed in bound volume.

When requesting a bibliography it is important to be very specific. For example, there are already some 7,000 reports on rocket research alone.

Once it has been determined through a bibliography or personal search at one of ASTIA's regional offices what reports pertinent to a project are already in the ASTIA

collection, the scientist can keep up-to-date through the semimonthly Technical Abstract Bulletin. ASTIA prepares quarterly and annual cumulative indexes to this Bulletin.

How to Use ASTIA. Any member of an activity of the Department of Defense is entitled to use ASTIA's service. A letter should be sent through the unit's commander to ASTIA requesting service. The unit will then be given a code number for its address.

The important rule to remember is that Army research personnel cannot request material from ASTIA directly. Requests must go through the unit commander.

Contractors doing business with Army research organizations can receive ASTIA's service by filling out an ASTIA Field-Of-Interest Register form, on which is indicated the contractor's special fields of interest. This form is approved by the contract project officer.

Once this form is filed with ASTIA, the contractor can request any reports within his designated field of interest. Secret reports are delayed approximately three weeks; they cannot be sent directly to the contractor but must go through the project officer.

Reports in stock can be sent to the user about three working days after receipt of the request. Reports which ASTIA has to reproduce presently take about nine days to get to the user. Automated processing equipment is expected to cut this to five days in the near future, it was stated.

ASTIA Libraries

Headquarters:
Arlington Hall Station, Arlington, 12, Va.; Tel: JA 5-5800 (Code 189), Ext: 482. TWX: ARL VA 155.
New York, N.Y.:
346 Broadway, Room 804, New York 13, N.Y., Tel: WO 2-5858.
Dayton, Ohio:
Area B. Building 47, Wright-Patterson AFB, Ohio, Tel: CL 3-7111, Ext: 35212.
San Francisco, Calif.
Building 1, Wing 2, Oakland Army Terminal, Oakland 14, Calif., Tel: TW 3-4100, Ext: 2222.
Los Angeles, Calif.
Building 1, Room 112, 125 South Grand Avenue, Pasadena, Calif., Tel: SY 6-0471, Ext: 591.

ASTIA automation has made it possible to process a new report and list it in the semimonthly Technical Abstract Bulletin within 33 days.

One advantage of the new automation system is that the computers keep a check on the demand for certain reports and then send orders for restocking, or "prestocking" as ASTIA calls it, the supply on hand.

ASTIA eventually hopes to develop a fully automated system that will handle all requests as fast as possible. And as the military research effort becomes greater and more intense, the scientist's need to know what research similar to his project has been conducted or is being conducted elsewhere will become more urgent. ASTIA is endeavoring to be able to satisfy this need.

Examining high-speed printer of UNIVAC computer, part of ASTIA's electronic data processing system, are (left to right) Lt Col William Hammond, USAF, Chief of the Data Processing Branch; Col Woodrow W. Dunlop, USAF, Commander and Director of ASTIA; Mr. J. H. Heald, Chief of the Document Processing Division; Mr. William A. Barden, Chief of Research Requirements Office, and Mr. John F. Stearns, Deputy Director of ASTIA, Arlington Hall, Va.

Directive Establishes Procedure for Series Of R&D Monographs

The Army is preparing to make available to the public in book form the significant research and development achievements of Army-conducted and Army-sponsored projects.

A directive by Army Chief of Research and Development Lt Gen Arthur G. Trudeau (R&D Directive No. 310-3, March 3, 1961) sets up the procedure for establishing the new series of publications to be known as U.S. Army Research and Development Monographs. An editorial board has been selected to encourage submission of the material and assure that only high quality material is included.

The board consists of Dr. Harold C. Weber, Chief Scientific Advisor, Office of the Chief of Research and Development, Chairman; Dr. Richard A. Weiss, Deputy and Scientific Director, Army Research Office (ARO), Vice Chairman; Mr. Charles E. McCabe, Chief Scientific Information Branch, ARO, Secretary; and members of the Senior Scientists Advisory Council, namely: Dr. G. H. Lee, Office of the Chief of Ordnance; Dr. C. M. Crenshaw, Office of the Chief Signal Officer; Dr. Ralph G. H. Siu. Office of the Quartermaster General; Dr. Maurice J. Murray, Office of the Chief Chemical Officer; and Mr. R. T. Kerr, Office of the Chief of Transportation.

Senior scientist positions in the Corps of Engineers and the Office of The Surgeon General are now vacant.

Engineers Testing Tractor Designed for Many Uses

Designed to meet modern warfare's demands for ultra-flexibility, a multi-purpose tractor that is both air-droppable and amphibious is under test by the U.S. Army Engineer Research and Development Laboratories, Fort Belvoir, Va.

The "Universal Engineer Tractor" has the capabilities of a scraper, grader, cargo carrier, dump truck and high-speed prime mover. Although light enough to meet airborne requirements, the UET is able to perform the work of heavy earth-moving equipment. This is accomplished through filling a front-loading ballast bowl with dirt or other available ballast, thereby doubling the weight of the empty vehicle and providing a maximum drawbar pull of 17½ tons, equivalent to a conventional tractor.

The UET is powered by a 250 hp., V-eight, liquid cooled, gasoline engine mounted at the rear of the vehicle. Controls are also in the rear to give the operator an unobstructed forward view of the ballast bowl during scraper-loading operations.

Ceramics Filling Critical Weaponry Needs

By Albert P. Levitt
Chief, High Temperature Materials Branch Watertown (Mass.) Arsenal Laboratories

Ceramics, important for thousands of peaceful purposes, most commonly for dishes, are developing as critical components for advanced weapons systems and space age missiles and rockets. In meeting rigid design requirements for weapons capable of dependable performance under extremely high temperatures, ceramics appear destined for a vital role.

Refractory, inorganic, nonmetallic materials whose manufacture requires intense heat, ceramics are classified generally as clays, glasses and oxides. Some investigators also consider graphite and the carbides, borides, nitrides and silicides of the refractory hard metals as ceramics.

Modern weapons systems call for significant improvements in thermal efficiency—materials that can withstand high temperature under many varying conditions. In rockets and guided missiles, for example, high temperatures are produced internally by the very hot exhaust gases of the rocket engine and externally by severe aerodynamic heating.

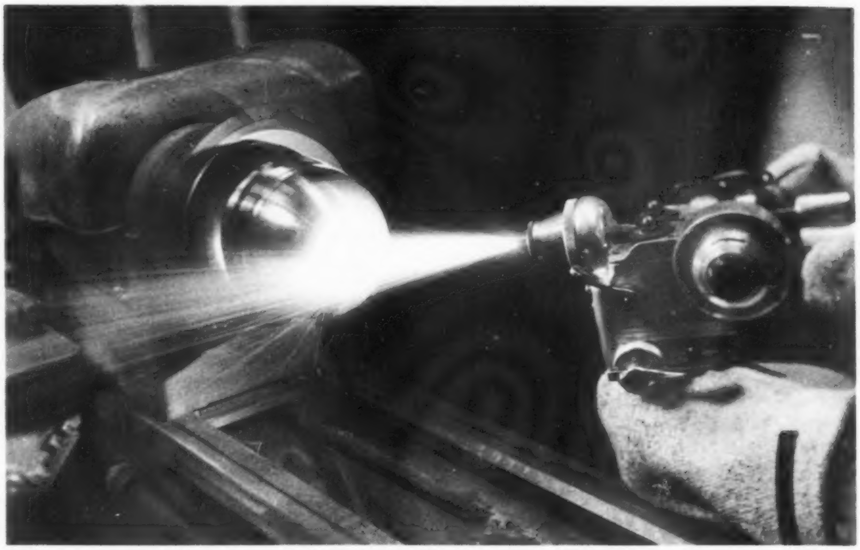
Relatively high temperatures are encountered in electronic components such as radomes, tubes, transistors and resistors. High temperatures must also be resisted in nuclear devices and in more conventional weapons such as mortars, antitank and antipersonnel guns, as well as tank and automotive engines.

In all these cases, the development of new and improved weapons depends increasingly on the availability of suitable heat-resistant materials.

Unfortunately, as operating temperatures increase, the number of suitable materials tends to decrease. As the limits of most engineering metals are now being reached or exceeded, interest has grown in ceramics because of their relatively attractive high-temperature properties, such as high melting point and high chemical stability.

One weakness sometimes cited in evaluating ceramic materials is their low tensile strength, low ductility, brittleness and, in some cases, low thermal shock resistance.

Because of a ceramic's capacity to remain stable and carry compression loads at temperatures where most engineering metals have no strength at all, it should be emphasized that many current deficiencies of ceramics can be overcome by the use of composite structures or ingenious designs. Chemical compatibility with changing environments also must be considered.



Flame-sprayed alumina coating is applied to experimental component of Davy Crockett missile system to guard metal from damage of hot corrosive gases.

The application of ceramics to weapons is very broad and may be divided into three major categories: structural, thermal insulation, electronic.

Current applications of ceramics to Ordnance weapons include: rocket nozzles (as throat inserts or coatings), combustion chamber liners, jetevators, missile radomes, missile nose cones, and missile control vanes and surfaces.

In these and other missile applications, ceramics are selected because of their high melting points, chemical stability, erosion resistance and low thermal conductivity — necessary to withstand the high temperature and velocity and erosive and corrosive gases. As missile radomes, ceramics have the additional advantage of being transparent to radar signals.

If weaponry means the science of developing and producing weapons, then the present and potential role of ceramics in metals processing and fabrication must be recognized. Ceramic crucibles provide the means for containing, melting and pouring metals, and ceramic molds are used for casting metals. Ceramic cutting tools, pioneered at Watertown Arsenal, speed up machining of hard metals because of their extreme hardness and heat resistance.

In order to meet the growing demand for new and improved materials, the Watertown Arsenal Laboratories have embarked on a broad High Temperature Research Program, with major effort in ceramics. Salient features are:

Thermal Properties. Reliable data is lacking at present on very high temperature properties of many ceramic materials—essential for their rational use in high temperature designs A special apparatus has been constructed for time studies to measure the thermal conductivity of selected refractory materials at temperatures up to 5,000° F. Total normal and spectral emissivity of several graphites have been measured up to 5,000° F.

Mechanical Properties. Because of the brittle nature of ceramic materials, special techniques must be devised to obtain reliable data about the high-temperature mechanical properties of ceramics. Current studies are aimed at measuring the high temperature elastic constants and tensile strengths of selected ceramics.

Improved Ceramics, Cermets. Research seeks improved control of the processing variables (such as purity, composition, particle size, and heat treatment) to produce high-strength ceramics. It appears that present-day ceramics can be improved by an order of magnitude by precise control of purity, microstructure, and the elimination of porosity in materials.

In the cermet area, the ZrO_2-Ti system is being investigated. The initial objective is to develop a strong chemical bond between the metal and ceramic through solid-solution formation during sintering, either direct or in situ. It is hoped this work will yield a cermet having improved impact and thermal-shock resistance.

Plastic-Ceramic Materials. Reinforcement of plastics by refractory ceramic fibers should yield a class of materials having very high strength-density ratios, and high temperature resistance, which can be molded into complex shapes with close tolerances. Plastics such as epoxy resins, polyesters, silicones, and phenolics, will be reinforced with ceramic fibers such as graphite, quartz, asbestos, high silicon glass, zirconia, potassium titanate and alumina.

In all cases the effects of fiber length and diameter, resin to fiber percentage, and fiber orientation will be investigated.

Flame-sprayed Coatings. The ability of flame-sprayed ceramic coatings to protect metals from high temperature corrosive gases has already been demonstrated with successful application of alumina coatings to experimental components of the Davy Crockett Missile System, such as cap ends, rocket nozzles, and rocket motor bodies.

Current research is aimed at: (a) improving the coating properties by optimizing the variables involved in the coating processes; (b) developing improved coating compositions; and (c) adapting these coatings to the solution of high-temperature problems in Ordnance equipment and in metals processing.

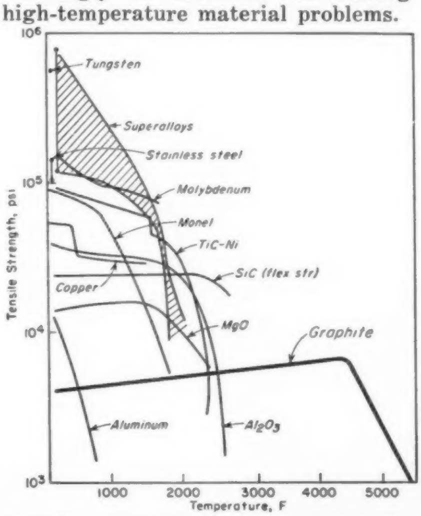
A plasma-spray unit has recently been acquired with the capability of generating temperatures up to 30,000° F. and melting any known materials. This unit can apply refractory ceramics (borides and carbides) whose melting points are higher than the temperature of an oxyacetylene flame.

Graphite Development. Graphite is a most attractive material for high-temperature service because of its very high melting point, low density, machinability, low cost and ready availability. Unlike other materials, its mechanical strength increases with temperatures up to about 4,500° F. Its disadvantages are a relatively low tensile strength and that it readily oxidizes, though several ceramic coatings have been developed which greatly reduce oxidization.

Current studies are directed at: (a) a systematic analysis of the processing variables to determine their effect on the properties of the resulting graphites; (b) the measurement and correlation of crystalline parameters, grain orientation. density, homogeneity, mechanical strength, and oxidation resistance; and (c) a basic investigation of the oxidation mechanism in graphite.

The role of ceramics in weaponry is firmly established. It should increase rapidly in importance as new techniques are devised for improving the high-temperature ductility, and reducing brittleness of these materials.

Research in progress indicates that while a "ductile" ceramic is not currently available for practical applications, remarkable improvement can be achieved by precise control of composition, purity and fabrication processes. As the operating temperatures of weapons systems trend higher, we will of necessity come to depend increasingly on ceramics for solving high-temperature material problems.



Tensile strengths of some ceramics and metals shown as temperature rises.

Secretary Stahr Stresses Army - Industry Link

"So deeply have the roots of technology sunk into the fundamentals of modern military activities that a present-day military planner without solid liaison with industry would be like a commander without a staff."

Secretary of the Army Elvis J. Stahr, jr., stated this conviction in a key speech to participants of the recent Army-Industry Liaison Seminar in New Orleans, La., cosponsored by the Army and the Association of the United States Army.

Secretary Stahr called for a strong Army capable of coping with future limited or brush wars, which he saw as more likely than an all-out global thermonuclear war.

"If the brush fires are promptly and effectively dealt with," he said, "they will not mushroom. I am a firm believer in massive retaliation if the true occasion for it should unhappily arise, but we must not permit ourselves to be maneuvered into a position in which our choice would be limited to all-out thermonuclear war on one hand or piecemeal surrender on the other."

Industry in supplying the soldier with necessary equipment, he said, "must focus attention not upon the factory alone, but upon the battlefield as well; not upon profit as the primary end, but upon the national interest as the transcendent consideration." National leaders, he contended, are looking to industry "more and more to contribute to our strategic planning."

Development of a modern American Army is critical, the Secretary stated, because "The Soviet Army clearly intends to be able to fight with or without nuclear weapons, and, under the 'umbrella' of the coming nuclear stalemate, to be prepared to foster and exploit weaknesses in the Free World wherever they (the Soviets) may sense they exist. . . .

Summary GEM Report Sold By OTS, Listed by ASTIA

Army Research Office Report No. 3, "The Ground Effects Phenomenon," prepared by R. L. Ballard, aeronautical research engineer in the Physical Sciences Division, is being distributed.

The report contains comprehensive information on all known American research in ground effects machines (GEM), including that sponsored by the military services and industry.

Qualified requestors may obtain copies of the report from the Armed Services Technical Information Agency (ASTIA), Arlington Hall Station, Arlington 12, Va. Government agencies not authorized to utilize ASTIA may obtain copies from the Office of the Chief of Research and Development, Department of the Army, Washington 25, D.C., Attention: Army Research Office.

Non-Government agencies not authorized to utilize ASTIA may obtain copies from the Office of Technical Services, Department of Commerce, Washington 25, D.C. The OTS order number for the report is PB 171,164. The price is 50 cents per copy.

ARPA Names Chief Scientist

Dr. George W. Rathjens has been appointed Chief Scientist of the Advanced Research Projects Agency. He succeeds Mr. George Sutton, who resigned to accept industrial employment.

Mr. Rathjens, on loan from the Institute for Defense Analyses, had been on the staff of Dr. George Kistiakowsky, Special Assistant to President Eisenhower for Science and Technology, for one year.

Inventor of "Rodriguez Well" Gains High Honors

An Army chemical engineer born and raised in the tropics has distinguished himself for work in the Arctic.

Raul (Rod) Rodriguez, chemical engineer wtih the Corps of Engineers, has been awarded the Department of Army Certificate of Achievement. He was nominated for the Arthur S. Flemming Award for developing a water supply for Camp Century, the Army's city under the snow in Greenland.

A native of Puerto Rico, Mr. Rodriguez was responsible for the concept, development of the method and equipment for drilling a subsurface well in glacial ice with the water being supplied by the continuous melting of ice in place.

Water thus obtained is stored safely within the glacier for delivery into an integrated water supply system. Known as the "Rodriguez Well," the system is able to supply 10,000 gallons of water a day for Camp Century.

Rodriguez's system involves using steam to melt a 3-to-4-foot diameter shaft in the dense glacial ice layers. Continued melting in the glacial ice forms a bell-shaped cavity, and the water produced is pooled in a subsurface pond from which it is pumped to the surface by a submersible type well pump.

Raul Rodriguez

Water in the well is kept from refreezing by maintaining the temperature at around 42 degrees.

In addition to drinking water, "Rodriguez's Well" provides water for the nuclear power plant at Camp Century.

The young engineer at the Corps' Research and Development Laboratories at Fort Belvoir, Va., also has been responsible for the successful solution of many other military water supply problems, having participated in the development of special water purification equipment, sea water desalting equipment, and ion exchange equipment for military field use.

Army Approves "Chinook" By Putting 18 on Order

The Army has ordered the first quantity production of the HC-1B "Chinook" helicopter, twin-turbine model capable of transporting 33 soldiers at a cruising speed of 130 knots.

The contract calls for 18 helicopters to be delivered between now and November, 1962.

The "Chinook," with a cargo capacity of three tons, loads through a rear cargo ramp, which may be left partially or completely open, or removed for flight. A 30-foot-long, 6½-foot-high, 8½-foot wide cargo compartment allows for carrying large size cargoes, such as Pershing missile system components and various sizes of Army vehicles.

Instrumentation is provided for all-weather flight. The 51-foot-long fuselage is 18 feet 7 inches at its highest point, with lift provided by two 3-bladed rotors with 59-foot diameters.

Two T-55-5 (Lycoming) turbine engines mounted on top of the fuselage deliver 2,200 shaft horsepower each. Normal operational radius of action is 100 nautical miles, with a service ceiling of more than 18,000 feet.

Dr. Weihe Chosen Editor Of New Infrared Physics

Dr. Werner K. Weihe, a Fort Belvoir scientist, has been named Executive Editor for the United States for *Infrared Physics*, an international research journal to be published by Pergamon Press, Ltd., of Oxford, England.

Infrared Physics is being established as an international research journal for the publication of scientific papers concerning infrared physics and its applications. It will be concerned with infrared theory, experiment, and instrumentation as applied to infrared detection and transmission, and to problems of atmospheric, meteorological, geophysical, astrophysical, and space research. It will contain research papers and specially invited critical surveys.

In addition to Dr. Weihe, editors of the new journal include M. Migeotte of Belgium, T. S. Moss of England, Sidney Passman of the United States, and an international editorial board. A regional editor for the U.S.S.R. is to be appointed.

Dr. Weihe, a recognized authority on infrared, is Chief of the Far Infrared Branch at the U.S. Army Engineer Research and Development Laboratories, Fort Belvoir. Born and educated in Germany, he has been employed at the Laboratories since December, 1945.

Army Sets Up Medical Research Lab in Thailand

The Army has established a medical research laboratory in Bangkok, Thailand, to conduct a continuing study program on infectious diseases in the area, including cholera, typhoid, hookworm disease, dengue fever, malaria, filariasis, and scrub typhus.

The first research laboratory of its kind to be set up by the United States in Thailand, the U.S. Army-SEATO Medical Research Laboratory is an outgrowth of research efforts by various U.S. Government agencies at the request of the Thai government during the 1958 cholera epidemic in Thailand.

Organizationally established as a special activity of the Walter Reed Army Institute of Research, Washington, D.C., the new laboratory will be directed by Lt Col Oscar Felsenfeld, Medical Corps. His staff will eventually consist of about 15 scientific and medical personnel.

The laboratory will be located at the Thai Army Institute of Pathology and will be attached to the Office of the U.S. Army Attache, American Embassy, Bangkok. Other member nations of SEATO have been invited to participate in the project.

Three General Officers Assigned to New Posts

Brig Gen George T. Powers III, Deputy Commanding General of the U.S. Army Ryukus Command and IX Corps in Okinawa, has been reassigned to the Army Air Defense Center, Fort Bliss, Tex., effective in July.

Col Charles F. Mudgett, Jr., Headquarters, U.S. Continental Army Command, Fort Monroe, Va., was reassigned to the Allied Land Forces, Southeastern Europe, effective this month.

Col Walter T. Kerwin, Jr., Office of the Chief of Research and Development, Department of the Army, will assume new duties at Headquarters, U.S. Army in Europe, in August.

President Kennedy recently nominated Cols Mudgett and Kerwin for promotion to brigadier general rank.

White Sands Man Wins Double Distinction for Missile Range Efforts

Ellis Howard Nolte, Chief of the Radar Division, U.S. Army Signal Missile Support Agency at the White Sands Missile Range, N. Mex., recently gained a double distinction.

For "distinguished application of his technical knowledge in the direction and execution of the Radar Division in supporting White Sands Missile Range and various projects of the Chief Signal Officer," Mr. Nolte received the Department of the Army Decoration for Meritorious Civilian Service. It was the first such award given at White Sands.

A Navy veteran in radar work, Mr. Nolte was assigned to White Sands Missile Range in 1950 as a member of Field Station No. 1 of what was then the Signal Corps Engineering Laboratories. The Field Station, which pioneered radar tracking and communications systems for the early missile programs at White Sands, then consisted of 125 military and civilian personnel. Today, 2,000 military and civilian workers man a $100 million communications-electronic plant in the guided missile program at America's largest land range.

Mr. Nolte received the Army decoration from Col Paul W. Albert. Commanding Officer of the Signal Missile Support Agency. It was the second of the Army's highest awards presented to Agency personnel. Ozra M. Covington, Technical Director, has received the Award for Exceptional Civilian Service.

Col. P. W. Albert presents award to Mr. E. H. Nolte as Mrs. Nolte looks on.

ORO Calls for Assay of R&D Effort

Technical effort has increased in volume at a rate only one-half the increase of funding during the past 10 years, and "there is a need for a realistic evaluation of investment in dollars versus man-years of effort in research and development."

Findings supporting these statements are contained in "A Proposed Cost-of-Research Index" report on studies made under Army contract with the Operations Research Office, Johns Hopkins University. The paper is authored by Dr. Ellis A. Johnson, ORO Director, and Mrs. Helen S. Milton, staff operations analyst.

Included in the report is a recommendation that the National Science Foundation "establish, in the national interest, a standardized R&D cost index . . . as an accepted indicator of national R&D technical effort." The authors point out that no criteria presently exist to indicate how much money is needed to support a required volume of technical effort.

Importance of knowing the factors of increased research costs, the report contends, is emphasized by its findings that the cost of research has advanced three times as much as the national cost-of-living index during the past decade.

From the viewpoint of adequate review and analysis of the R&D programs of the U.S. Armed Forces, the report emphasizes that there are some critical areas in which the absolute dollar support has increased though less actual technical effort is resulting than in 1950.

Provocative of rising interest since it was placed in the "open literature" category of Operations Research Office publications, the report defines the technical man as "the professional scientist or engineer, together with his supporting technical, administrative and housekeeping staff," including machines and equipment—that is, the man plus overhead costs.

Two questions to be answered in formulating a permanent index, the report states, are: How much has the cost per technical man increased owing to all causes during the past 40 years? How has this affected the actual R&D effort?

The preliminary index compiled by the authors was based on studies of 17 individual research organizations selected because their primary missions were in representative fields of research as conducted by large industry, foundation, government and small private laboratories, and R&D divisions.

The study indicates that the rising cost of equipment and increases in salaries for younger scientists and technicians have been two major factors in the rising cost of R&D during the past decade; also, that theoretical research tends to cost less per technical man-year than R&D.

The report does not attempt to justify or criticize the relevant factors making research increasingly expensive. It merely stresses that unless these factors are known, sound budgeting practices cannot be followed.

"It is essential to remember," the report concludes, "that future returns of R&D to military effectiveness and the national economy are dependent on the actual scientific and engineering effort in these fields. . . . An R&D index based on cost per technical man-year provides an approach to determining the actual versus the dollar investment in R&D."

Engineer Corps Awards Big Minuteman Contract

The U.S. Army Corps of Engineers has awarded a $61,773,644 contract for the construction of Minuteman intercontinental ballistic missile operational facilities at Malmstrom Air Force Base, Great Falls, Mont.

The award was made to George A. Fuller Co. and the Del E. Webb Construction Co., Los Angeles, Calif. Facilities to be constructed will be the first of a number of underground dispersed units for operational deployment of the Minuteman.

AMRC Seeks Improved Ground Mobility

By S. J. Knight
Chief, Army Mobility Research Center
U.S. Army Engineer Waterways Experiment Station

The present U.S. Army concept of battle is of small but powerful, widely and deeply dispersed units, assembling rapidly to strike devastating offensive blows, and then, purpose accomplished, immediately redispersing to escape retaliatory nuclear attack.

Turning this concept into reality depends upon vastly increased mobility on the ground and in the air. The mobility envisioned by military strategists is not of convoys moving along roads and aircraft operating from permanent airfields. Rather it is of ground and air vehicles moving swiftly and surely, without regard to road nets or airfields.

Aircraft to meet the challenge of this concept have been developed in profusion to fill almost every foreseeable requirement. Ground vehicles, by contrast, have remained essentially frozen in the same old patterns. Obviously, some progress has been made in improving the cross-country performance of vehicles. *But where is the parallel of the fantastic improvements in the aircraft industry? Why has ground transport development lagged?*

The reason probably is that it has been more feasible and economical to build highways and roads than to develop better cross-country vehicles. However, military needs of the future demand the development of better cross-country vehicles. Today, survival and cross-country mobility may be more closely related than realized.

The Corps of Engineers has established a ground mobility research laboratory at the U.S. Army Engineer Waterways Experiment Station, Vicksburg, Miss., called the Army Mobility Research Center (AMRC). The mission of the AMRC is to perform research aimed at producing a fuller understanding of the principles of vehicle movement on all kinds of terrain. Emphasis will be on wet, fine-grained soils since they present the greatest obstacles to off-road movement. This understanding is expected to serve as a basis for design of military (and commercial) vehicles with improved cross-country capabilities.

The principal facilities of the AMRC are housed in a single building with 30,000 square feet of floor space. Supplementary indoor and outdoor service areas are located nearby. A total of 16,000 square feet is used for an operational area, 8,000 square feet for office space, an instrumentation center, and a data reduction room, and 6,000 square feet for soils and general storage areas and a small soils laboratory. Several hundred yards from the main building is an annex which houses special apparatus for investigating the reactions existing between soils and large wheels.

The principal wheel track and soils research apparatus consists of a cantilever structure supporting a carriage to which the vehicle model is attached. Other components are a line of cars filled with soils on which the vehicle travels, equipment for measurements of soils strength, a stationary soils processing plant, a mobile soils processor, and a track system.

Grid of tracks in 16,000-square-foot operational area of Army Mobility Research Center, Vicksburg, Miss., enables soil-filled cars (lined up at left) to be moved about to vary conditions during research into wheel-load/soil effects.

The soils-car transfer system, a significant feature of the AMRC facility, consists of a track network upon which the soils cars can be moved forward, backward, and sideways. This permits concurrent model investigations, preparation of soils for the following study and rehabilitation or disposal of soils used in the previous study.

The cars are heavily reinforced, welded steel tanks, 6 feet wide at the top, 3 feet wide at the bottom, and 3 feet deep, mounted on casters; their capacity is 13 cubic yards. The tracks are shallow half-oval rods welded to a flat steel plate which is flush with the floor and extends over the entire operational area.

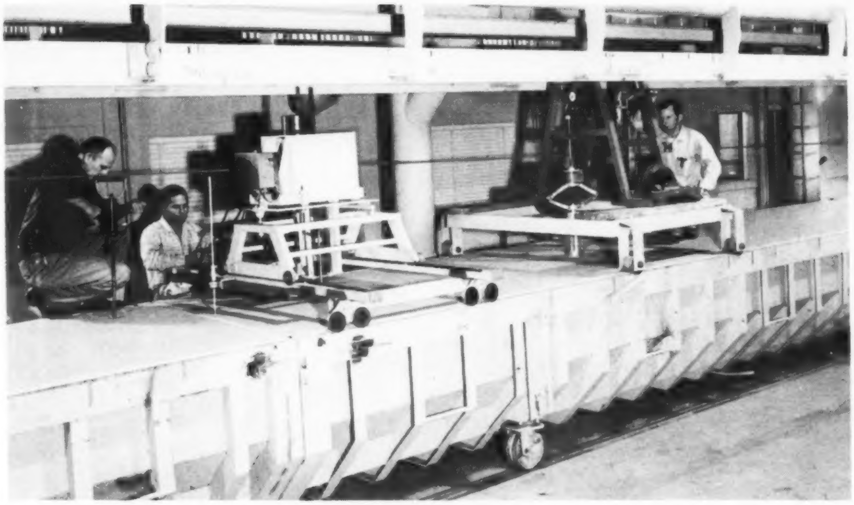
The principal operations in the research investigations in the AMRC are: processing and analysis of soils, study of interactions of wheels and tracks with the soils, taking and recording of measurements, and reduction of the resulting data for analytical purposes.

Soils preparation is one of the most important and difficult operations in the mobility research laboratory because even small changes in soils properties will significantly affect vehicle performance. The AMRC soils processing plant, consisting mainly of a disintegrator-pugmill and a mobile processor, is capable of producing a large, homogeneous soils mass with the desired characteristics.

The properly processed soils are placed in two soils cars which are instrumented by pressure cells placed within the soils mass at specified locations. The strength of the soils in the cars is measured by the cone penetrometer, the bevameter, and a torque shear vane.

The cone penetrometer has been mechanized and instrumented so that cone index profiles can be measured at the touch of a button, and the penetration resistance-depth curve is recorded in the instrumentation center. Plans have been made for the automation of the other strength-measuring instruments. Samples are also extracted for moisture content, density, and laboratory-strength investigations.

The two filled soils cars are moved into the center section of a line of six empty cars. The two cars at each end of the line are then filled with the same type soils used in the cars being studied, but the soils are not



Soil-strength tests being carried out simultaneously involve use of (left to right) British shear vane, cone penetrometer and bevameter for measurements.

necessarily at the same moisture-strength condition.

The line of cars, 165 feet long, is centered under the cantilever structure, on which is hung a pair of carefully aligned rails. A lightweight carriage, made of high-strength aluminum, is suspended from four wheels which ride the rails. Attached to the underside of the carriage is a high-strength aluminum subcarriage to which any suitable wheeled or tracked vehicle model or component can be bolted. The vehicle model may be used either as a towed or self-propelled vehicle.

The test apparatus is large enough to accommodate a wheel with an outside diameter of 32 inches, equivalent to a 9.00-14 tire. This is comparable in size to tires used on many military vehicles, and is not less than one-fourth the largest size tire in existence today. (An apparatus that will accommodate wheels up to 50 inches in diameter and 24 inches in width and that can be modified to accommodate wheels up to 80 inches in diameter and 36 inches wide is housed in another building.) Track models, which generally consist of one track only, can be studied at one-fourth to one-third the size of those of most existing full-scale vehicles.

Vertical loads on the investigative models may be varied by adding 25-pound units of lead up to a maximum of about 3,000 pounds. Horizontal or tow loads for self-propelled models may be set by varying the drive motor control of the main carriage.

The vehicle model can be made to reverse and return in the same path to its starting point; or it can be lifted, returned to the starting point, and made to repeat its run in the same path. The subcarriage and attached vehicle model may be moved left or right of the original path, at the touch of a button, thus permitting efficient utilization of the entire width of the soils cars.

Close-up of tow-test on model wheel.

Investigations which the vehicle model yield information on the dynamic variable of speed, horizontal force, sinkage, slippage, rolling resistance, tractive effort, variation in vertical load due to up-and-down movement of the test apparatus, flexing of pneumatic tires, and stress induced by the vehicle model on the surface of the soils and at points within the soils mass.

Measurements are converted into electrical signal analogs, transmitted through cables to the instrumentation center, and recorded on three light-beam oscillographs and one magnetic tape recorder. As soon as records are available from a given run they are processed through data-reduction equipment to determine rapidly maximum, minimum, or average values of the various parameters measured.

Problems in the AMRC research are similar to many other engineering problems in that they are concerned with the measurements and relation of stresses and strains. Complicating factors are the many vehicle and soils variables involved, the fact that the stresses and strains are constantly changing as a vehicle moves through the soils, and the difficulty of measuring stresses and strains in soils.

The AMRC laboratory, with its facilities for the careful control and measurement of vehicle and soils features, and its flexibility and speed of operation, is ideally suited for the engineering research needed to develop the principles of vehicle operation on all kinds of terrain.

Weapons systems, no matter how superior they may be, and troops, no matter how well trained, are fully effective only insofar as they can be deployed to maximum advantage—only insofar as they can be delivered as needed to accomplish a military objective. ARMC research is geared to the urgency of this requirement—speedy, dependable transportation through development of a family of vehicles geared for combat conditions.

ARO Author Delineates Progress on Fuel Cells

Support from the U.S. Department of Defense, particularly the Department of the Army, has greatly spurred worldwide interest in the field of fuel cells—electrochemical devices for converting chemical energy directly to electrical energy.

The importance of Army support of fuel cell research and development is noted in an article on fuel cells published in the Feb. 15 issue of *Electronics Design*. Author of the article is Ernst M. Cohn, of the Army Research Office, Office of the Chief of Research and Development.

The article discusses briefly the basic components of a fuel cell and describes in some detail the operation of various types of fuel cells and fuel-cell systems.

During the past year, Mr. Cohn states, a "phenomenal change" has occurred in that a large number of organizations have suddenly taken an active interest in fuel cells and, almost without exception, this interest has centered on hydrocarbon as an ultimate fuel source and air as an oxidant.

Notwithstanding the production of workable fuel-cell systems, the author concludes that a considerable amount of research and development is still needed before a practical, long-lived, dependable fuel cell, operating on organic compounds and air, can be realized.

Radios in Shells Tell Gun Barrel Pressure

Physicists at the U.S. Army Ordnance Corps Ballistic Research Laboratories of Aberdeen Proving Ground, Md., have installed radios in 105mm artillery shells to measure pressures in the gun tube when the shell is fired.

Weighing 12 ounces, and about the size and shape of a bottle of ink, the radio consists of miniaturized coils, condensers, transistors, batteries and resistors tied together with fine copper wire imbedded in a sturdy plastic molding.

Microwave signals are sent out from a transmitter-receiver placed near the gun through an antenna beamed at the gun's tube. The signal travels down the gun barrel striking a minute antenna on the nose of the shell which relays the signal to the shell's radio.

The shell's radio then retransmits the signal back to the transmitter-receiver after modification by a pressure gauge or accelerometer within the projectile. All this happens in one-fiftieth of a second—the time it takes the projectile to pass through the gun tube.

The signal is received at a nearby control room and fed to a bank of oscilloscopes. The light beams appearing on the face of the 'scopes are photographed in complete darkness by ultra-high-speed cameras.

The whole operation, firing the gun, turning off the lights in the control room, and starting the cameras and oscilloscopes, is accomplished simultaneously by the pushing of one button.

Prior to the adoption of this system, time consuming and expensive modifications had to be made to the gun itself to secure these measurements.

Mr. Larry Peters, physicist with Ballistic Research Laboratories, Aberdeen Proving Ground, Md., inserts miniaturized radio in nose of 105mm artillery shell. Designed by Mr. Peters, Mr. Webster M. Kendrick (wearing topcoat) and Mr. Paul H. Sellers, also BRL physicists, shown preparing radio-equipped shell prior to test firing, radio is used to obtain and transmit data on shell acceleration and tube pressure during firing. The method saves time and money.

German Shows Techniques For Plastic Plane Parts

A new method of manufacturing reinforced plastic for rotor blades on helicoptors and propellers and landing gears for small fixed-wing craft was outlined recently to USATRECOM scientists and engineers by Dr. Ulrich Hutter.

Professor and Director of the Aeronautical Design Department at Stuttgart Institute of Technology, Stuttgart, Germany, Dr. Hutter showed slides that graphically demonstrated the unlimited possibilities of reinforced plastics in the field of aeronautics. Two short films depicted methods of fabrication using fiberglass roving and plastic resin.

CRREL Joins AEC in Alaska Project Chariot

The U.S. Army Cold Regions Research and Engineering Laboratory (CRREL), formerly of the U.S. Army Snow, Ice and Permafrost Research Establishment (SIPRE), is cooperating with the Atomic Energy Commission in a program of research to discover peaceful uses for atomic energy.

Project Chariot, in which CRREL is participating, envisions a cratering experiment at Cape Thompson, Alaska, north of the Bering Strait, that may demonstrate the feasibility of nuclear explosives for large-scale excavations.

One plan AEC has under consideration would call for detonating four 20-kiloton bombs (each equivalent to 20,000 tons of TNT) at the bottoms of four large-diameter holes 400 feet deep, to form a ditch, and a 200-kiloton bomb 800 feet deep near one end of the ditch, to produce a large crater. In effect, the nuclear excavation would create an artificial harbor.

Prior to construction of the explosive emplacement holes, a bioenvironmental survey has been conducted to gather data on possible damage to plant and animal life in the area. Also in advance of preparations for the excavation work, CRREL staff members have supervised the drilling of two holes—one 1,000 feet deep and the other 1,200 feet deep—to obtain subsoil and rock samples of the ground.

Soil cores recovered at 100-foot levels from these holes have been sent to both the CRREL laboratories at Wilmette, Ill., and the U.S. Geological Survey, Department of the Interior, for study. In addition, thermistors (semiconductor resistance thermometers) attached at regular intervals to a cable have been lowered into each drill hole, and temperature readings for the various levels have been sent to CRREL and USGS.

One result of the temperature study is the discovery that while the ground is frozen to a depth of 1,150 feet at the 200-kiloton site, the permafrost extends only to 950 feet in the hole close to the shore. The ocean has a warming effect on the ground and the permafrost is continuously thawing from below.

Current studies in connection with Project Chariot will contribute to arctic biology, meteorology and geology. Also of value will be increased knowledge of the effects of sudden releases of large energy concentrations on ground temperature distribution.

Named USAERDL Executive

Lt Col Earle C. Mellet has been assigned Executive Officer of the U.S. Army Engineer Research and Development Laboratories, Fort Belvoir, Va. He succeeds Lt Col Victor C. Gray who retired from the Army after 20 years of service.

Col Mellett comes to his new post from Chehel Dokhtar, Iran, where he served 12 months as Area Engineer under the U.S. Army Engineer Gulf District.

DOD Asks Over 30 Firms For VTOL Aircraft Bids

More than 30 potential contractors have been invited to submit proposals for various VTOL transport aircraft for operational suitability testing under a tri-service program to develop such a plane.

To be funded equally by the three services over a 4-year period, the project was planned by a working group initiated by the Director of Research and Development of the Army and the Assistant Secretaries of the Navy and Air Force for Research and Development.

Approximately two months will be allowed for preparation of the proposals to be submitted to the Bureau of Naval Weapons, development agency for the project, and the contractor will be selected by July, 1961.

Major characteristics and performance goals of VTOL aircraft are: operation from unprepared sites and amphibious assault ships with an 8,000-pound payload; maximum speed, 300 to 400 knots; cruise speed, 250 to 300 knots; and a hovering capability of 10 minutes.

SC Outlines R&D Results In 100 Years of Progress

Progress in military communications—from semaphore wigwagging to space satellite signaling — is sketched in a report titled "One Century of Research" published by the U.S. Army Signal Research and Development Laboratory (USASRDL), Fort Monmouth, N.J.

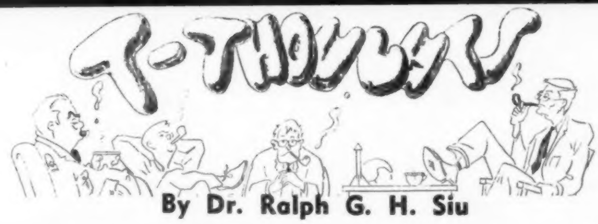
Intended to provide in narrative form a condensed summary highlighting some of the Signal Corps' major unclassified technical achievements during its first 100 years of service to the Nation, the report was prepared by Dr. Harold A. Zahl, Director of Research, USASRDL.

In the early 1900's the Signal Corps became responsible within the Army for two major developments: radio and aviation, both of which expanded enormously during World War I. Thereafter, until the early thirties, Signal research slipped back to only a token nature, with less than 100 Signal R&D personnel working in Washington, Wright Field and Fort Monmouth. By the mid-thirties, however, the Corps was deep in a project of highest priority: radar.

World War II again brought a virtual halt to research by the Corps, emphasis being diverted to advanced developments, quick-fixes, crash production, supply, maintenance and training. The war picture for the Corps, the report notes, became one in which outside sources contributed breadboard models for study, evaluation, test, and production.

Advent of the space age brought the Corps' first century to a dramatic close and provided an immense stage for the opening act of its second century. The report concludes:

". . . Whatever the country, the Department of Defense, or the Army, looks to the Signal Corps for—that trust shall be handled in accordance with the highest traditions our century-old inheritance symbolizes; ready for combat if need arises—and in science, looking forward to even greater strides; in peace it is hoped —but always PRO PATRIA VIGILANS!"



By Dr. Ralph G. H. Siu

We hear many explanations for intellectual infertility: depressing environment, excessive harassment, ambiguous guidance, inadequate personnel, deficient funds, insufficient time, and so on. Similar complaints have existed for centuries, as you know. It is not surprising, therefore, to read about the great poet-philosopher Friedrich Schiller having to bend a sympathetic ear to the same subject in his day. His letter of reply to his bemoaning friend on Dec. 1, 1788, may be of some interest in our own revival of the problem. The relevant excerpt follows:

"The reason for your complaint lies, it seems to me, in the constraint which your intellect imposes upon your imagination. Here I will make an observation and illustrate it by an allegory. Apparently it is not good—and indeed it hinders the creative work of the mind—if the intellect examines too closely the ideas already pouring in, as it were, at the gates.

"Regarded in isolation, an idea may be quite insignificant and venturesome in the extreme, but it may acquire importance from an idea which follows it; perhaps, in a certain collocation with other ideas, which may seem equally absurd, it may be capable of furnishing a very serviceable link. The intellect cannot judge all these ideas unless it can retain them until it has considered them in connection with these other ideas.

"In the case of a creative mind, it seems to me, the intellect has withdrawn its watchers from the gates, and the ideas rush in pell-mell, and only then does it review and inspect the multitude. You worthy critics, or whatever you may call yourselves, are ashamed or afraid of the momentary and passing madness which is found in all real creators, the longer or shorter duration of which distinguishes the thinking artist from the dreamer. Hence your complaints of unfruitfulness, for you reject too soon and discriminate too severely."

Dr. Siu Picked in Top 10 Federal Career Employes

(*Continued from page 1*)

recently established Army research and development series—a significant collection of research results being published in book form."

Dr. Siu's versatility as a scientist and his penetrating inquisitiveness serve him well as the Quartermaster Corps' Chief Scientist. He must concern himself with the basic research and development for the Corps' multibillion dollar annual procurement of food, clothing, supplies, motor vehicles and a great variety of other equipment. He is also responsible for the designs of the flags, seals and other heraldic devices used by the Federal Government.

Dr. Siu obtained his B.S. degree in Chemistry in 1939 and his M.S. degree in Plant Physiology in 1941 from the University of Hawaii, and his Ph.D. in Bio-Organic Chemistry in 1943 from the California Institute of Technology. From 1943 until he transferred to the Quartermaster Corps in 1945, he was an assistant chemist at the Department of Agriculture.

Dr. Siu is known to readers of the *Army Research and Development Newsmagazine* for his column: "T-Thoughts on Research and Engineering Management," and is also a regular contributor to the magazine's "Provocative Ponderables" column.

USAERDL Officer Retires

Lt Col Victor C. Gray, Executive Officer of the U.S. Army Engineer Research and Development Laboratories, Fort Belvoir, Va., since November 1958, retired from the Army Feb. 28.

Col Gray entered the Army in January 1941 and served in the Southwest Pacific during World War II. Later he served in the Mediterranean theater and in Formosa and Guam.

Research Spurred on Masers, Lasers, Irasers

By Dr. Robert B. Watson, Physical Sciences Division, ARO, OCRD

Masers, lasers and irasers, electronic devices which produce amplification by stimulated emission of radiation from atoms or molecules, are receiving intensive investigation from Army research organizations because of importance to military equipment.

These components proved a boon to such important activities as long distance radar ranging into space and as frequency standards in highly accurate clocks and timing devices for missiles and space vehicles. They form part of the electronic backbone of Army equipment used for weapons sighting, surveillance, target detection, satellite tracking, and scatter communication systems.

The major advantage of these devices over vacuum tubes and transistors are precision, noise-free operation and the capability of being used at the higher frequencies now utilized in space and other areas of research.

The word maser is an acronym for Microwave Amplification by Stimulated Emission of Radiation, reflecting its initial use in the microwave frequency region. This nearly noise-free device has provided the best known amplifier, making possible studies of radio noises from other planets in our solar system, and other stars in the universe.

The maser's almost noiseless operation proved very useful in radar ranging the planet Venus. Its ability to give extremely accurate measurements of frequency allowed a very precise time standard to be established.

As *maser* is the designation for the devices utilized in the microwave region, *laser* designates the devices utilized in the visible light region of radiation and *iraser* designates the devices operating in the infrared region.

It has been suggested that masers, lasers and irasers, which differ only in the region of frequency in which they operate, should be classified under the general acronym *quaser*, from Quantum Amplification by Stimulated Emission of Radiation.

Studies of quasers grew out of basic research started at Columbia University by Prof. C. H. Townes during World War II. The early research was supported by the Signal Corps and the Navy, which were later joined by the Air Force in the current joint contract with Columbia's Radiation Laboratory.

Army activities have been concentrated within the Signal Corps, which, besides sponsoring a number of contracts, has developed a research capability in this field at Fort Monmouth's Research and Development Laboratory. The Laboratory also has technical monitorship for the Army's participation in the joint service university contracts.

Dr. Theodore H. Maiman, Hughes Aircraft Co. scientist, shows cube of synthetic ruby crystal, which enables laser to generate "coherent" light.

Synthetic ruby crystal (top) is the "heart" of electronic device called a laser. Ruby reradiates in a sharp beam the light absorbed from random waves emitted by light source below.

Other joint service contracts with universities include those being fulfilled by Harvard University's Cruft Laboratory, Stanford University's Microwave and Electronics Laboratories, and the Polytechnic Institute of Brooklyn.

One reason for the almost noiseless operation of masers is that they operate at a much lower temperature (about —455° F.) than vacuum tubes (about 1,800° F.) or transistors (about 80° F.). This advantage is slightly offset because of the complex and extensive equipment needed to maintain the maser's very low operating temperature.

Lasers and irasers also promise to solve present problems of our overloaded communications system by making more frequencies available. Their frequencies are above the radar range, even above frequencies corresponding to millimeter wavelengths—those of infrared and visible light. No other devices produce amplification of an essentially single wavelength in these very high frequency and short wavelength regions.

While research has demonstrated that amplification in these regions is possible, the work is only now reaching the stage where practical devices are becoming possible.

Used principally for amplification, quasers can also be used for oscillation—the production of significant power at microwave, infrared and visible light frequencies. Prof. Townes first proposed a maser oscillator in May 1951, and an outline of a proposed practical device appeared in the Columbia Radiation Laboratory Quarterly Progress Report in December 1951.

Suitable generators of microwave frequencies, however, such as the magnetrons, have been known for years. The only purpose of developing the quaser oscillator, therefore, is that it is the only known device producing essentially a single wavelength at infrared or visible light frequencies.

Possibility of producing appreciable amounts of power from quaser oscillators is in the early research stage. The very short wavelengths involved appear very attractive for producing sharp beams of radiation allowing transmission over great distances with minimum loss due to spreading. Such quaser oscillator transmissions would be quite secure since there would be little radiation except in the direction of the sharp beam.

As mentioned earlier, one important application of these devices is in the production of an exceedingly accurate

frequency standard or time standard.

One of the fundamental quantities in any physical measurement is time, and the control of missiles, satellites and inter-planetary vehicles depends on extremely accurate timing systems. The frequency stability of a maser, which depends only on frequencies associated with atomic or molecular activities, leads to a relatively simple method of obtaining the necessary time accuracy.

A recent Signal Corps development in this field is the Atomic Cesium Beam Maser. This allows use of a frequency standard with an accuracy of one part in 10^{10} and a stability of two parts in 10^{11} per day, with no measurable long-term drift. Such a standard is so precise that it would deviate from true time about one second in 300 years, or about one microsecond in three hours!

A maser osciliator such as here described could be used in missiles for communications purposes, to operate at a frequency of about 300 mc., with a stability under missile environmental conditions of one part in 10^9 and a frequency change under an acceleration of 30g's of less than three parts in 10^{10}. These high accuracy frequency standards were used successfully for the recent worldwide synchronization of atomic clocks, known as Project WOSAC. (See Dec. R&D *Newsmagazine*, page 21.)

Special emphasis in the Army's quaser program is planned immediately for basic research to provide a proper basis for further applied research and development.

Outside and inside views of medium Army tank equipped with television to enable machine's operation while "buttoned up," as may be necessary in combat on an atomic battlefield. In combat, cameras and power system mounted atop tank (upper view) would be protected by installation inside armored vehicle.

Driving Tank Using Television Eyes to Outside Aimed at A-Threat Readiness

Against the day when a tank must be capable of operating in battle areas contaminated by atomic radiation, the Human Engineering Laboratories of the Army Ordnance Corps, Aberdeen Proving Ground, Md., are investigating the feasibility of tank driving by television.

Operating on an atomic battlefield would require the tank to function while completely "buttoned up" for the protection of its crew. A periscope solution has not proved workable; besides, its user might suffer eye damage from the flash of an atomic explosion.

A television system installed inside a tank permitting visual observation of surrounding terrain has been tested by the Laboratories.

The Army's "mechanical mule" vehicle was selected for the initial experiment. The steering wheel, brakes and accelerator were replaced by a "joy stick" and the clutch became a hand-release system mounted on top of the shift lever.

Pushing the "joy stick" forward fed more gas and speeded movement. Pulling it to the rear slowed the vehicle and applied brakes. The vehicle could be steered by moving the stick to right or left.

Commercial television equipment was employed. A vidicon camera was mounted at eye level and to the right of the driver's head. A horizontal field of view of 45° and a vertical field of 37° were obtained by use of a one-half focal length lens.

A 17-inch home portable television receiver was mounted 17 inches from the driver's eyes at a viewing angle of 30° below the horizontal. An Army Signal Corps power unit furnished power for the monitor. An inverter supplied power for the vidicon camera.

While the drivers selected for the tests were skeptical of their ability to handle the vehicle, they soon gained confidence. They operated the "mule" over several courses offering a wide variety of driving conditions from open road to cross-country, muddy and rutted trails.

Such factors as loss of depth perception and color cues decreased in importance as the tests went on. The drivers learned by experience to make compensations. A tendency to turn too soon on curves was partially corrected by training. Laboratories' observers believe the addition of pan and tilt capabilities to the vidicon camera might eliminate the problem.

The next step will be to install the TV system in a modified Patton tank. A higher resolution system will be employed to obtain a more detailed picture. The lens will permit a wider horizontal field and the camera can pan and tilt to assist the driver on curves.

An automatic iris will be installed to compensate for changing light conditions and a filter will be employed to protect the vidicon tube from damage by direct sunlight.

Initially, Human Engineering Laboratories want to test the system while the driver is in a supine position. *This may be the first time the Army encouraged a tanker to "lie down" on the job.*

Management School Graduates Advised on Problem Areas

Over-organization, restriction of needed flexibility of operations, increased costs, and the too hasty introduction of new management techniques are dangers Army management specialists must guard against.

General James F. Collins, the newly appointed Commanding General, U.S. Army Pacific, recently stated this conviction to graduates of the U.S. Army Management School, Fort Belvoir, Va. Until last month General Collins was Deputy Chief of Staff, Personnel, Department of the Army.

Stating he is "convinced that we have a tendency to over-organize our establishment," General Collins warned that the "dangers are much more deep-rooted than mere wastes of manpower."

An increase in the number of supervisors and organizational elements, according to General Collins, "complicates channels . . . lengthens our lines of vertical communication and fills them with nonessential material. . . .

"Management can be hamstrung in its efforts to reapportion workload or change certain procedures because they cross organizational lines. . . . Related tasks may be so broken up that something which should be handled by a single individual requires the involvement of several people in other subdivisions."

The way to avoid over-organization, General Collins said, is "by setting up initially the most austere structure to perform new missions. . . . It is always easier to add really needed elements to our structure than it is to cut back an overstaffed organization."

Another trend to be watched, he said, is that "toward more executives or managers compared with workers." Studies indicate this "is just as great in staff management occupations as in the professional and scientific fields."

Though some increase in the number of executives and managers in comparison with workers may be an indication that management efficiency has been able to cut the work force, too often, General Collins contended, "we find that organizations—military and civilian—have become top-heavy with no gain in efficiency. . . .

"The increased cost of this kind of management service is justified, providing it results in an improved end product, greater output per worker, or better utilization of funds, material and facilities. We should take a close look at further increases in the number of people in staff management occupations to make sure that we don't go beyond the point of reasonable return from our investment."

Col W. W. Culp, Commandant, U.S. Army Management School, presents certificate of appreciation to General James F. Collins, recently promoted to 4-star rank and appointed Commanding General, United States Army, Pacific.

Another danger to proper management of Army activities, as viewed by General Collins, is the too hasty introduction of new management techniques. The tempo and pace of some management changes "have been beyond the Army's capacity to assimilate them in an orderly manner," and can "detract from, rather than further, realization of Army objectives."

Three essential elements of successful command and management are, in General Collins' opinion, decisiveness of the leaders, effective communications and sound personnel management. Delegation of authority enhances decision making but it is necessary "to keep down the number of people who have to make decisions. . . . Communications must go up, down and sideways. . . .

"The commander must know enough of the situation to make an intelligent decision," but "should not be bothered with reports and statistics still being forwarded on some earlier matter because someone is making a career of a once essential report"

General Collins stressed that a commander's decisions must be understandable, saying:

"Obviously no matter how wise the decision, or how courageously made, no move will be taken unless the troops get the word on time and in a form they understand. . . . The Army needs rapid, accurate and *selective* communications. . . . Top management officials are frequently so deluged with reports on details that they are delayed in making decisions on the main issues. At lower levels commanders are often overwhelmed with nonessential data."

General Collins cited beneficial results of recent efforts to upgrade the quality of Army personnel, such as the Army Enlisted Management Program, the new Program for Warrant Officers, the Long-Range Active Duty Program, and the improvements in the Civilian Personnel Management Program. These personnel programs are important, he said, but effective utilization of manpower can be effected only by "the highest order of leadership to derive the maximum contribution. . . .

"The most successful commander or manager is the one who gets his personnel to work with him. He recognizes that the productivity of a group of men is not merely the sum of the productivity of the individuals in it. The quality of leadership and esprit of the organization greatly affect the capabilities of a military unit and the productivity of an industrial work force.

"The commander or manager must work within policies and guidelines established at the top echelon. These policies must be progressive, competitive with those in other fields and capable of being administered. We in the Army personnel field believe that our policies are among the best in the country. . . ."

Col Woodward Assigned As Chief of WSMR Unit

Lt Col V. E. Woodward has succeeded Col Arthur L. MacKusick as chief of the Integrated Range Mission at White Sands Missile Range, N.M.

Col Woodward headed the IRM's Range Measurement Division since March 1959. Previously he was deputy chief of the Ammunition Branch, Industrial Division, Office of the Chief of Ordnance, at the Pentagon for three years. During World War II he served in the European theater and took part in landings at Casablanca, French Morocco, Licata, Sicily, and Salerno, Italy.

3 Generals in Army R&D Given New Assignments

Brig Gen Elmer J. Gibson, has been assigned to the U.S. Army Ordnance Weapons Command, Rock Island Arsenal, Ill. He was formerly Assistant Chief of Staff, G-4 (Logistics), Eighth U.S. Army, Korea.

Brig Gen Oren E. Hurlbut, Commanding General, U.S. Army Ordnance Weapons Command, Rock Island Arsenal, has been assigned to Eighth U.S. Army, Korea.

Brig Gen James B. Lampert, formerly Deputy Chief for Logistics and Administration, Military Assistance Advisory Group, Vietnam, was recently assigned to the Office, Chief of Army Engineers, Washington, D.C.

Capital Group Acclaims USAERDL's Dr. Cox as Outstanding Scientist

Dr. J. Thomas Cox, civilian scientist at the U.S. Army Engineer Research and Development Laboratories, Fort Belvoir, Va., recently received the National Capital Award as the "outstanding young applied scientist" in Metropolitan Washington, D.C.

Announcement of his selection, along with that of the outstanding young engineer and outstanding young architect, was a highlight of the annual observance of Engineers' Week sponsored by the D.C. Council of Engineering and Architectural Societies and the Washington Academy of Sciences.

The award to Dr. Cox was based on his outstanding work and important contributions in the field of vacuum coatings and their applications. He has developed new types of coatings and film combinations useful as reflective coatings for glass and infrared filters of semi-conducting materials. He is the author and coauthor of many papers on optical applications of vacuum-deposited thin films, for publication and presentation at scientific or technical meetings.

Dr. Cox was graduated in 1950 with a B.S. degree from the College of William and Mary, Williamsburg, Va., where he was a Phi Beta Kappa student. He received his Ph.D. from Duke University, Durham, N.C., in 1954, and has been employed since September 1954 at the Laboratories. He is the second employee of the Laboratories to receive such an award. In 1959 Horace Leathers, a mechanical engineer, was designated outstanding young engineer in the area.

Dr. J. Thomas Cox

Ordnance Scientists Complete Polar Studies Aimed at Long-Range Goal of Weather Control

John A. Brown and Emmett J. Pybus work on hygrometer in antarctic shop.

Studies directed toward knowledge that some day may enable man to gain a significant measure of control of the weather have been successfully completed in the Antarctic—less than 800 miles from the South Pole—by two scientists of the Army Ordnance Ballistic Research Laboratories of Aberdeen Proving Ground, Md.

The first studies of water vapor in the upper atmosphere in the Antarctic were carried out by John A. Brown and Emmett J. Pybus of the Applied Physics Branch of the Laboratories' Ballistic Measurement Laboratory. The two men launched 13 instrumented balloons to altitudes up to 130,000 feet, well into the stratosphere.

Work of the Army scientists was sponsored by the National Science Foundation, with a view to determining dew point in the south polar regions and its effect on weather conditions throughout the earth.

During the antarctic operation the Army team learned that there is a definite correlation between water vapor density and temperature in the upper atmosphere. During the antarctic summer the stratosphere is relatively dry, but their last balloon launching, on Feb. 3, indicated a thousand-fold increase in water vapor content of the stratosphere. Whether this phenomenon was caused by the approach of winter, or caused the approach of winter, is not yet known but will be the basis for future studies.

A second activity of the two scientists was to provide, if possible, background information for Dr. Albert P. Crary of the National Science Foundation for his study on whether the ice mass of the Antarctic is increasing or decreasing. Occurrence of the latter could eventually result in the inundation of the earth's coastal areas and major river valleys adjacent to the oceans due to a rise in the mean sea level.

Mr. Brown and Mr. Pybus had previously made intensive studies of the dew point through balloon launchings in the Arctic as well as in the tropics in Panama. Their studies in the Antarctic enabled them to compare data with earlier findings in the north polar regions.

As a result of the recently completed studies, the Ballistic Research Laboratories can take pride in being the only agency in the world known to have accomplished this significant work in both polar regions.

Maj Gen Dick Assigned CG Of 3rd Infantry Division

Maj Gen William W. Dick, Jr., Deputy Chief of Research and Development, has been reassigned to U.S. Army Europe as the Commanding General of the 3rd Infantry Division, effective in May.

General Dick was assigned to the Office of the Chief of Research and Development in September 1958 as Director, Special Weapons, and was promoted to the office of Deputy in July 1960.

His previous duty includes tours as Commanding General 7th Army Artillery, Chief of Staff, 7th Army; and with the U.S. Army Element, Headquarters Detachment, Joint Task Force 7.

General Dick saw combat in World War II and in Korea. He is a 1931 graduate of the United States Military Academy.

TRECOM Loses 3 Key Men Totaling 71 Years of Duty

Three key personnel at the U.S. Army Transportation Research Center, Fort Eustis, Va., with a total of 71 years of Federal service have retired. They are Lt Col Robert W. M. Weir, 28 years, Percy D. Fuller, 23 years, and Lt Col Paul A. Dierkes, 20 years.

Col Weir was Technical Liaison Officer at USATRECOM, Col Dierkes, Deputy Chief of the LARC (lighter, amphibious, resupply, cargo) Task Group, and Mr. Fuller was Chief of the Marine and Terminals Branch of the Surface Directorate.

Aberdeen Proving Ground "Tortures" Mobile Equipment

"Frame twister" road tests an Army truck at Aberdeen Munson test course.

Engineers of the Army Ordnance Corps Development and Proof Services, Aberdeen Proving Ground, Md., have developed torture tests for Army mobile equipment that make the torture experts of history—Torquemada, Attila the Hun, and the Marquis de Sade—look like pikers in comparison.

The staff of Col Gilbert P. Dubia, Director of this unique Ordnance Corps activity, have as their goal the insurance that Army combat equipment is dependable under any condition of terrain, weather or other military factors.

The organization has the mission of testing and evaluating for the Army and other services new developments in the automotive field. The item under test can be a tiny "mechanical mule," one of the new M-60 tanks, a new 175mm self-propelled gun, the Army's self-propelled Pershing missile's carriage, or an aluminum truck.

Most of the testing performed by Development and Proof Services falls under the heading of either development and engineering (pre-production), or quality insurance (during production).

The primary test areas used at Aberdeen are Munson, Perryman, and Churchville, covering 3,400 acres and including all types of test roads and terrain conditions.

The Munson test area consists of 29 courses designed to drown, rack, bend, jolt, vibrate or tear tanks, trucks and other vehicles to pieces on a continuous destructive run. The vehicles shudder over concrete "washboards" that vary from two to six inches to see if parts loosen or fail.

Slopes varying from 5 to 60 percent check the vehicle's brakes, fuel-system efficiency and resistance to oil starvation while it "stands on its tail."

Tanks and trucks grind their tracks, spin wheels, and strain drive shafts along an 800-foot stretch of 2-foot-deep loose sand.

The mud course or "hog wallow," a 300 by 1,000-foot bowl of mud, was designed to gum up anything not properly sealed. It provides a powerful abrasive for wearing out parts improperly protected. An independent, piped water supply permits controlling and maintaining the condition of the mud regardless of season.

Many vehicles are also required to roll over a series of huge alternating humps or "frame twisters," or heave and shudder across a mile of wavy, lumpy "Belgian blocks."

Other tests in the Munson area may force the vehicle to plunge through the controlled-soil basin, where mud is made to any desired consistency, and to tow a mammoth dynamometer that "drags its heels" just to make things tougher. Or the vehicle may go through a fording basin almost completely submerged in water, slam through a carefully engineered shell hole 4½ feet deep, and span an adjustable gap to test its "bridging" ability. Tanks clamber over vertical walls 30 inches high and onto side slopes up to 40 percent.

The Perryman test area, about 3,000 acres and essentially flat, is used principally for rough cross-country testing of vehicles and contains four courses of graduated severity.

The vehicles are loaded to capacity to test pulling power, speed, braking, maneuverability, suspension systems and shake-apart characteristics on road conditions ranging from thick dust to soupy mud.

Included in the Perryman test area is a 3-mile paved straightaway course with banked turnaround loops at each end, used for speed, cooling system, and durability tests. A gun mount test road provides six miles of secondary road operation for gun carriages and small trailers.

The Churchville test area is made up of a series of steep hills, part of which are heavily wooded. The test courses have been laid out over and around hills in a closed loop of four miles, containing sections with grades in excess of 30 percent as well as sharp curves. Prepared mud slopes are used for controlled tests to evaluate the tractive ability of vehicles.

Col Dubia and his "torturers" seek the answer to a constant question: "Is this vehicle good enough for the American Army and the American soldier?" Gruelling test conditions at Munson, Perryman and Churchville—mud, water, dust, hills, curves, Belgian block, speed, drag and heavy loads—enable them to come up with a fairly definite answer.

Medium tank scales 40-inch wall in one of many tests conducted by Army Ordnance Development and Proof Services for wheel and tracked vehicles at Aberdeen Proving Ground, Md., to determine combat equipment capability.

Calendar of Scientific Activities

With this issue the *Army Research and Development Newsmagazine* initiates a calendar of upcoming scientific and technical meetings pértinent to Army research and development.

The calendar will aim to inform Army R&D personnel of meetings they may want to attend or which may be a source of papers pertinent to their professional duties.

The editors request that the appropriate R&D organizations inform them of meetings of interest to the magazine's readers, especially those sponsored by the Army or in which Army R&D personnel are scheduled to participate.

14th Annual Assembly of the International Institute of Welding, New York, N.Y., Apr. 12-18.

4th Conference on Great Lakes Research sponsored by the Great Lakes Research Division, Institute of Science and Technology, University of Michigan, Ann Arbor, Apr. 17-18.

Annual Symposium on Instrumental Methods of Analysis sponsored by the Instrument Society of America, Apr. 17-19.

7th West Coast Classified Military Operations Research Symposium (WCCMORS) sponsored by ONR/Pasadena, at Boeing Airplane Co., Aerospace Division, Seattle, Wash., Apr. 17-19.

Annual Meeting and Welding Exposition of American Welding Society, New York, N.Y., Apr. 17-21.

Symposium on Chemical Reactions in the Lower and Upper Atmosphere sponsored by the Stanford Research Institute, National Science Foundation, National Institutes of Health, ARPA, and the Chemical Sciences Directorate of AFOSR, San Francisco, Calif., Apr. 18-20.

5th Navy Science Symposium, U.S. Naval Academy, Annapolis, Md., Apr. 18-20.

International Symposium on Microbial Reactions in Marine Environments, Chicago, Ill., Apr. 20-24.

American Society for the Study of Sterility, Annual Meeting, Miami Beach, Fla., Apr. 21-23.

63rd Annual Meeting, American Ceramic Society, Toronto, Ontario, Canada, Apr. 23-27.

61st Annual Meeting, Society of American Bacteriologists, Chicago, Ill., Apr. 23-27.

Annual Meeting, Aerospace Medical Association, Chicago, Ill., Apr. 24-26.

Symposium on Structural Dynamics of High-Speed Flight, sponsored by ONR and the Aerospace Industries Association, Los Angeles, Apr. 24-26.

American Physical Society, Washington, D.C., Apr. 24-27.

12th Plenary Meeting, International Committee of Electrochemical Thermodynamics and Kinetics, Brussels, Belgium, Apr. 24-29.

Conference on High-Temperature Materials, American Institute of Mining, Metallurgical and Petroleum Engineers Inc., Cleveland, Ohio, Apr. 26-27.

Detonation and Deflagration Phenomena Conference, American Rocket Society, Palm Beach, Fla., Apr. 26-28.

7th Aerospace Instrumentation Symposium, Fort Worth, Tex., May 1-4.

Electronics Components Conference, sponsored by the Institute of Radio Engineers, American Institute of Electrical Engineers, Electronics Industries Association, Western Electronic Manufacturers Association, San Francisco, Calif., May 2-4.

International Conference on Detection and Use of Tritium in the Physical Biological Sciences sponsored by the International Atomic Energy Agency, Vienna, Austria, May 3-10.

Society for Pediatric Research, Atlantic City, N.J., May 4-5.

Society of Neurological Surgeons, Boston, Mass., May 5-6.

Chemical Engineering Symposium, sponsored by the American Institute of Chemical Engineers, Chemical Engineering Division, and the Chemical Institute of Canada, Cleveland, Ohio, May 7-10.

Hydraulics Conference, sponsored by the American Society of Mechanical Engineers, Engineering Institute of Canada, Montreal, Canada, May 7-10.

Lubrication Conference, sponsored by the American Society of Mechanical Engineers, Miami Beach, May 8-9.

4th National Power Instrumentation Symposium sponsored by the Instrument Society of America, Chicago, Ill., May 8-10.

National Aeronautical and Navigational Electronics Conference, sponsored by the Institute of Radio Engineers, Dayton, Ohio, May 8-10.

Western Joint Computer Conference, sponsored by the American Institute of Electrical Engineers, Institute of Radio Engineers and Association for Computing Machinery, Los Angeles, Calif., May 9-11.

Production Engineering Conference, American Society of Mechanical Engineers, Toronto, Canada, May 10-12.

Spring Meeting, Acoustical Society of America, Philadelphia, May 11-13.

American Radium Society, Colorado Springs, Colo., May 11-13.

9th Annual Meeting, Radiation Research Society, Washington, D.C., May 15-17.

Microwave Theory and Techniques National Symposium, sponsored by the Institute of Radio Engineers, Washington, D.C., May 15-17.

Spring Conference, Building Research Institute, Washington, May 16-18.

R&D Symposium on Propellant Actuated Devices sponsored by the Army, Frankford Arsenal, Philadelphia, Pa., May 17-19.

American Association of Plastic Surgeons, New York, N.Y., May 17-19.

10th National Telemetering Conference, sponsored by the American Institute of Radio Engineers, Instrument Society of America, American Rocket Society, Institute of Aeronautical Sciences, Chicago, May 22-24.

"Jones says no more scientific breakthroughs from him until the air conditioner in that back room is fixed!"

LAW Packs Powerful Punch Against Tanks

A new 4½-pound U.S. Army light anti-tank weapon capable of knocking out any known tank has been developed by the Army Ordnance Missile Command, Huntsville, Ala.

Named the LAW, the weapon can be carried and fired by one man from its own disposable packing container, which gives it an appearance similar to that of the famed "bazooka." It can be fired from a prone, kneeling or standing position.

Officially known as the XM72 Rocket Grenade, the LAW has proved effective in tests against tanks and other armored vehicles, earth and log emplacements, sand bag fortifications, and concrete bunkers.

The Army Ordnance Corps Human Engineering Laboratories at Aberdeen Proving Ground, Md., were given the supporting mission of conducting human operations and safety tests of the weapon starting more than two years ago. Sound tests were conducted in an effort to reduce firing noise, an ever-present problem of the soldier in combat. Different types of sighting devices were studied because in firing the LAW the opportunity to "zero in," as in firing a rifle, is not present.

The simplicity of operation of the LAW makes possible an extremely short period of instruction, following which a trained soldier can aim and fire it in 15 seconds. The launcher is 25 inches long and 3 inches in diameter. With four rounds of ammunition it can be carried in a canvas pack slung over the soldier's shoulder like a quiver of arrows.

Demonstrating the Army's new anti-tank weapon, the LAW, are its developers James Torre (standing) and Robert Gschwind, Aberdeen Proving Ground, Md.

A solid-fuel motor furnishes propulsion and burns out before the rocket leaves the tube. When the projectile emerges, several narrow magnesium fins spring into position and stabilize the rocket in flight.

Aiming is accomplished by a rear peep sight and a graduated sight printed on a clear plastic rectangle mounted at the mouth of the launcher tube. The warhead uses a powerful new Army Ordnance Corps-developed explosive known as OCTOL.

The Department of the Army has stated that when teamed with the 90mm recoilless rifle, the new rocket grenade will further satisfy the infantry soldier's need for protection against enemy tanks.

9 Fort Belvoir Employees Recognized for Good Work

"Outstanding" and "Sustained Superior Performance" awards and certificates of promotion to higher Civil Service grades were presented recently to nine employees of the U.S. Army Engineer Research and Development Laboratories and the Geodesy, Intelligence and Mapping Research and Development Agency (GIMRADA), Fort Belvoir, Va.

Certificates for outstanding work were awarded to Dr. Georg H. Hass, Dr. Werner K. Weihe, George D. Crowson and T. David Cooper.

A Sustained Superior Performance award and a $150 check went to Percy W. Johnson. An identical certificate and $250 were given to Robert E. Dudley. Certificates of promotion to higher grades were presented to Dr. Robert S. Wiseman, George E. Brown and Gerard J. King.

This was the fifth Outstanding rating for Dr. Hass, who is Chief of the Physics Research Laboratory and a recognized authority on optics and thin film coatings, and the third such award to Dr. Weihe, Chief of the Far Infrared Branch and an authority on far infrared.

Mr. Cooper, employed in the Electric Power Branch, and Mr. Crowson, employed in the Evaluation Branch, also have received Outstanding ratings in the past. The Sustained award to Mr. Johnson was his first and was in recognition of his work as a mechanic in the Equipment Maintenance Branch. Mr. Dudley received his award for work in the Map Compilation Branch.

Dr. Wiseman, Chief of the Warfare Vision Branch, was promoted to GS-15, Mr. Brown, employed in the Far Infrared Branch, to GS-14, and Mr. King, employed in the Basic Research Laboratory, to GS-13.

SC Copes With Blackout In Arctic Communication

The Signal Section of U.S. Army Polar Research and Development Center has installed the AN/TST 101 tropospheric scatter communications system to cope with the problem of radio blackout in the Arctic.

Such blackout occurs when radio signals transmitted fail to bounce back from the ionosphere toward the ground, but instead continue to travel out into space. Signals from the tropospheric scatter system are bounced back to the receiving stations because of a diffusion of energy from the main wave front in the troposphere.

Tested since 1959 at the U.S. Army Electronic Proving Grounds at Fort Huachuca, Ariz., tropospheric scatter equipment has been found to have a high degree of reliability over distances of 50 to 300 miles, without being affected by atomospheric or auroral disturbances.

Wareless Warehouse Stores Records of Parts Elsewhere

A unique warehouse for the storage of missile parts has been completed at the Redstone Arsenal, Huntsville, Ala.

Though the warehouse supplies missile parts for Army units all over the world, no missile parts are kept at the warehouse, and the workers actually never see them.

Called the Missile And Rockets Inventory Control Center Of The Army Ordnance Missile Command, the warehouse houses an electric computer which stores the inventory of missile parts.

Orders are received by direct wire transmission providing a machine card with its mesage punched out for the computer. The computer then provides a card for direct transmission to the manufacturer for Army depot that will supply the part and, also, orders new items replacing those from stock.

The computer's memory units store information from the machine cards on magnetic tapes that maintain correct records of missile and related ground support equipment parts.

Engineer Corps Merging 2 Cold Weather Agencies

The Snow, Ice and Permafrost Research Establishment (SIPRE) of Wilmette, Ill., has been redesignated the U.S. Army Cold Regions Research and Engineering Laboratory (CRREL) and the Arctic Construction and Frost Effects Laboratory (ACFEL) of Waltham, Mass., has been placed under the command jurisdiction of CRREL Director, Col W. L. Nungesser.

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GIMRADA Advances Technique of High Speed Mapping

Stephen W. Gibson
Chief, Map Reproduction Section
Topographic Systems Branch,
GIMRADA

Designed to meet requirements evolving from combat concepts for the future is a map display, reproduction and distribution system being developed by the U.S. Army Engineer Geodesy, Intelligence and Mapping Research and Development Agency (GIMRADA), Fort Belvoir, Va.

A number of high level studies on concepts and organization of the army of the future indicate that the following will hold true:

a. The field army will be dispersed over a much wider area than any previously considered. In addition to assuming control of this wider area, it is believed that the field army will influence an area well beyond the forward combat elements.

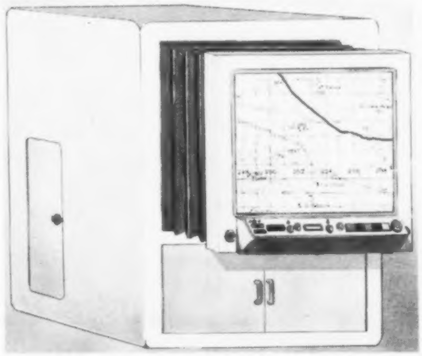
b. To effectively cover this area with the number of troops assigned, all units must be extremely mobile and able to react quickly to changes in the tactical situation.

c. The area between combat elements will not be physically occupied but will be lightly held by reason of constant patrolling and surveillance.

It can be seen that each of the foregoing statements, when applied to map production and distribution, leads to the obvious conclusion that the requirements for mapping and map distribution will be increased tremendously when compared with World War II and Korean experience.

The system under development includes the use of 70mm microfilm, in color for display purposes and in the form of black and white color separated positives or negatives for reproduction, an automated viewer for storage and display, an electrostatic printing system for reproduction, and new concepts for the distribution of the printed maps.

The viewing device is the Target Map Coordinate Locator being built by Fairchild Camera and Instrument Corporation under an R&D contract. It is designed to store and make readily accessible 11,000 color or black and white microfilms of maps, charts, and other intelligence data. The map sheets are coded and indexed when the films are placed in the unit.



Sketch of GIMRADA's map viewing device that makes accessible within seconds 11,000 microfilms of maps.

Retrieval and projection of the desired information is accomplished by dialing the coding information into the machine. Any of the 11,000 sheets will be ready for viewing at 1:1 (full size) within 15 seconds. Coordinates of a selected point on a map can be easily obtained by moving "X" and "Y" cross hairs on the screen to the desired point and reading the coordinates from dials on the console.

The number of maps that can be microfilmed and stored in this machine would occupy nearly 17 cubic feet if stored in the original size in one stack. A usable system for filing these maps is estimated to triple the amount of space required.

The reproduction method under development is the electrostatic printing system. Using 70mm microfilm as the master, the system is sufficiently flexible to reproduce efficiently one or 10,000 or more copies, in monochrome or multicolor.

In addition, the projection method of producing the image with 70mm microfilm, permits the designer considerable freedom in laying out the press configuration. Feasibility studies have shown that a 5-color machine, to produce the conventional 22½" x 30" topographic map, can be designed to fit in the standard topographic equipment van body which is 17' long, 89" wide, and 84" wide.

Work on the electrostatic printing system is being done by Harris-Intertype Corporation under an R&D contract with GIMRADA. A single color printing unit will be delivered in September 1961 for engineering tests in the GIMRADA laboratories. The results obtained will be used in the design and fabrication of a 5-color unit which is due in June 1963.

The use of this system leads to the consideration of new concepts for map reproduction and distribution. Since the printing unit will occupy only one van, it would be possible to put this equipment in the hands of the map user—perhaps the division engineer. Microfilms instead of maps will be distributed and the maps can then be reproduced on demand in the quantity needed.

The ability to do this eliminates the necessity of stocking map depots with all possible map sheets in anticipation of their use. Reports from World War II and Korea indicate that only about 10 percent of the printed maps were ever used. The remaining 90 percent had to be printed, however, since there was always the possibility that they might be needed.

With this new concept, only those maps that are needed will be reproduced, and only in the quantities required. Since the reproduction capability is very close to the user, the system is extremely responsive to the varying demands. This concept will reduce the security problem as only the microfilms, occupying a fraction of the space required by the same maps, will require security treatment.

Technical Services Participate in ARO-D Operation Crossfire

Guiding principles for operational procedures being established for the Army Research Office-Durham, in line with the recent transfer of the Office of Ordnance Research to ARO control, were discussed at a Mar. 8-9 meeting in Durham, N.C.

Key Army physicists particiated in *Operation Crossfire*. The result was compilation of a list of all topics of a fundamental nature in a particular science supported by the Army, either in-house or in the outside scientific community through basic research grants or contracts.

The stated purpose of Operation Crossfire was: (1) To acquaint Army scientists with work in basic research areas at in-house laboratories; (2) to inform Army scientists more adequately regarding details and integration of the overall basic research program; (3) to encourage and facilitate communication and cross-fertilization of ideas among Army scientists; and (4) to pinpoint subareas of mutual interest which require additional emphasis.

Crossfire was initiated by the Office of Ordnance Research last year. With ARO-D (Army Research Office-Durham) responsibilities in the physical and mathematical sciences broadened greatly by the reorganization effected Jan. 19, 1961, representatives of all the Technical Services and major Army laboratories participated in the Mar. 9 meeting. Additional meetings are planned to adopt procedures.

Brig Gen Ryan Assigned As Director of OCRD Plans and Management

Brig Gen William F. Ryan, presently Commander of artillery troops of the Fourth Armored Division, has been assigned to the post of Director of Plans and Management, Office of the Chief of Research and Development, effective May 15.

General Ryan's military career began in 1924 when he enlisted in the New York National Guard, serving with a horse-drawn artillery outfit. He was graduated from the United States Military Academy in 1933.

During World War II he was commander of the 402nd Field Artillery Battalion, 42nd Division, which fought its way from eastern France across Germany to Munich.

In the Korean conflict he was executive officer, IX Corps Artillery, and later Assistant Chief of Staff, G-3, Eighth Army.

Following his Korean tour General Ryan headed the Development Division, Office of Chief of Research and Development. In 1956 he became Deputy Commander and later Commanding General, U.S. Army Element, Armed Forces Special Weapons Project, Sandia Base, Albuquerque, N. Mex. He has attended the Army Command and General Staff College.

Brig Gen William F. Ryan

Participants in a recent meeting in Durham, N.C., on operation of the new Army Research Office-Durham (ARO-D) included (left to right) Dr. William H. Martin, Duke University President Dr. Deryl Hart, ARO-D Chief Scientist Dr. John W. Dawson, Chief of Research and Development Lt Gen A. G. Trudeau and Dr. J. E. Vance. Martin and Vance are on Army Management Subpanel.

Army Shows Rapid Growth In Basic Research Grants

In less than 11 full months of operation since the basic research grants program was inaugurated by the Chief of Research and Development, it has expanded to include work in 126 universities and colleges funded at $5,-317,276. The program is carried on under Public Law 85-934.

Basic research funded by grants currently total approximately 10 percent of the total $54 million expenditure for basic research. As reflected in the current Army Research Task Summary, the Army's total annual research expenditure (basic and applied) is at the rate of $188,487,949.

DOFL Engineer Presented Achievement Award by Academy of Sciences

Dr. Romald E. Bowles, Chief of the Nonradio Systems Branch of the Diamond Ordnance Fuze Laboratories, Washington, D.C., recently received from the Washington Academy of Sciences its Outstanding Achievement Award for 1960 for his work in the field of engineering sciences.

A native of Washington, Dr. Bowles was awarded B.S., M.S. and Ph. D. degrees in engineering from the University of Maryland. Prior to joining the DOFL staff, Dr. Bowles served on the staff of the Naval Ordnance Laboratory as a mechanical engineer, was senior engineer at the Applied Physics Laboratory, Johns Hopkins University and was research scientist at the Redstone Arsenal, Ala.

In addition to his work at DOFL, he lectures at the University of Maryland, where he also serves as engineering consultant. He is a registered professional engineer, and a member of the Institute of the Aeronautical Sciences, the American Nuclear Society, American Ordnance Society and National Geographic Society.

Dr. Romald E. Bowles

5,000 to Attend D.C. Parley Featuring Defense Electronics

More than 5,000 key men in the military services and industry will attend the 15th annual convention of the Armed Forces Communications and Electronics Association in Washington, D.C., June 6-8.

Nearly 200 major Government contractors will take part in the industrial exhibit, displaying the progress being made in defense communications. The importance of electronics to the Nation's defense is attested by the fact that more than half the industry's sales are military products.